

HORTICULTURE

Instructional-cum-Practical Manual

Volume VI

FLORICULTURE

A K. DHOTE
Project Coordinator



राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

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NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

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Foreword

The programme of vocationalization of Higher Secondary education has been accepted by the country as it holds forth great promise for linking education with the productivity and economic development of the country by providing education for better employability of the youth

In view of the importance of the programme, the NCERT is making an all out effort to provide academic support to the implementing agencies in the States. One of the major contributions of the NCERT is in the field of curriculum development and in the development of model instructional materials. The materials are developed through workshops in which experts, subject specialists, employers' representatives, curriculum framers and teachers of the vocational course are involved. These materials are then sent for try-out in schools and feedback is collected through questionnaires and through direct contact. The materials are also sent to experts for comments before they are published.

The present manual on Floriculture has been developed in the manner described above and is meant for the students studying Horticulture and allied vocations. It is being published for wider dissemination amongst students and teachers throughout the country. I hope that they will find the manual useful.

I am grateful to all those who have contributed to the development of this manual. I must acknowledge also the immense interest taken by Prof. A.K. Mishra, Head, Department of Vocationalization of Education in inspiring his colleagues in their endeavours to develop instructional materials. Dr. A.K. Dhote, Lecturer, functioned as Project Coordinator for the development of this title in association with Dr. A.K. Sacheti, Reader. They have my appreciation and thanks for planning, designing and conducting the workshops, for technical editing and for seeing this manual through the Press.

Suggestions for improvement of this manual will be welcome

P L MALHOTRA
Director
National Council of Educational
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Preface

Ever since the introduction of vocationalization in our school system by several States in our country, the paucity of appropriate instructional materials has been felt as one of the major constraints in the implementation of the programme and a source of great hardship to pupils offering vocational studies at the Higher Secondary stage

The Department of Vocationalization of Education of the National Council of Educational Research and Training, New Delhi, has started a modest programme of developing instructional materials of diverse types to fill up this void in major areas of vocational education. The task is too gigantic to be completed by any single agency but the model materials being developed by us might provide guidance and impetus to the authors and agencies desiring to contribute in this area. These are based on the national guidelines developed by a working group of experts constituted by the NCERT.

The present manual is on "Floriculture" and is a common portion of the Horticulture/Vegetables and Fruits/Fruit Preservation and Processing or related courses in a number of States. It contains activities (Practical Exercises) to be performed by pupils with simple steps to follow, precautions to be taken and data to be obtained and processed. Each activity is complete with brief theoretical information, objectives, expected behavioural outcome, evaluation, etc. It is hoped that the pupils will find them immensely useful.

The manual has been developed by a group of experts as authors in a workshop held at the University of Agricultural Sciences, Hebbal, Bangalore (Karnataka). The names of experts are mentioned elsewhere and their contributions are admirably acknowledged. Our thanks are also due to Dr. S. K. Bhattacharjee, Head, Division of Medicinal and Aromatic Crops, IIHR, Bangalore for the pains he took in verifying the authenticity of contents of the manual. Dr. A. K. Sacheti, Reader and Dr. A. K. Dhote, Lecturer, DVE deserve special thanks for editing and bringing the materials in the present form. The assistance of all in the UAS, Hebbal, Bangalore (Karnataka) and Department of Vocationalization of Education, NCERT, is also gratefully acknowledged.

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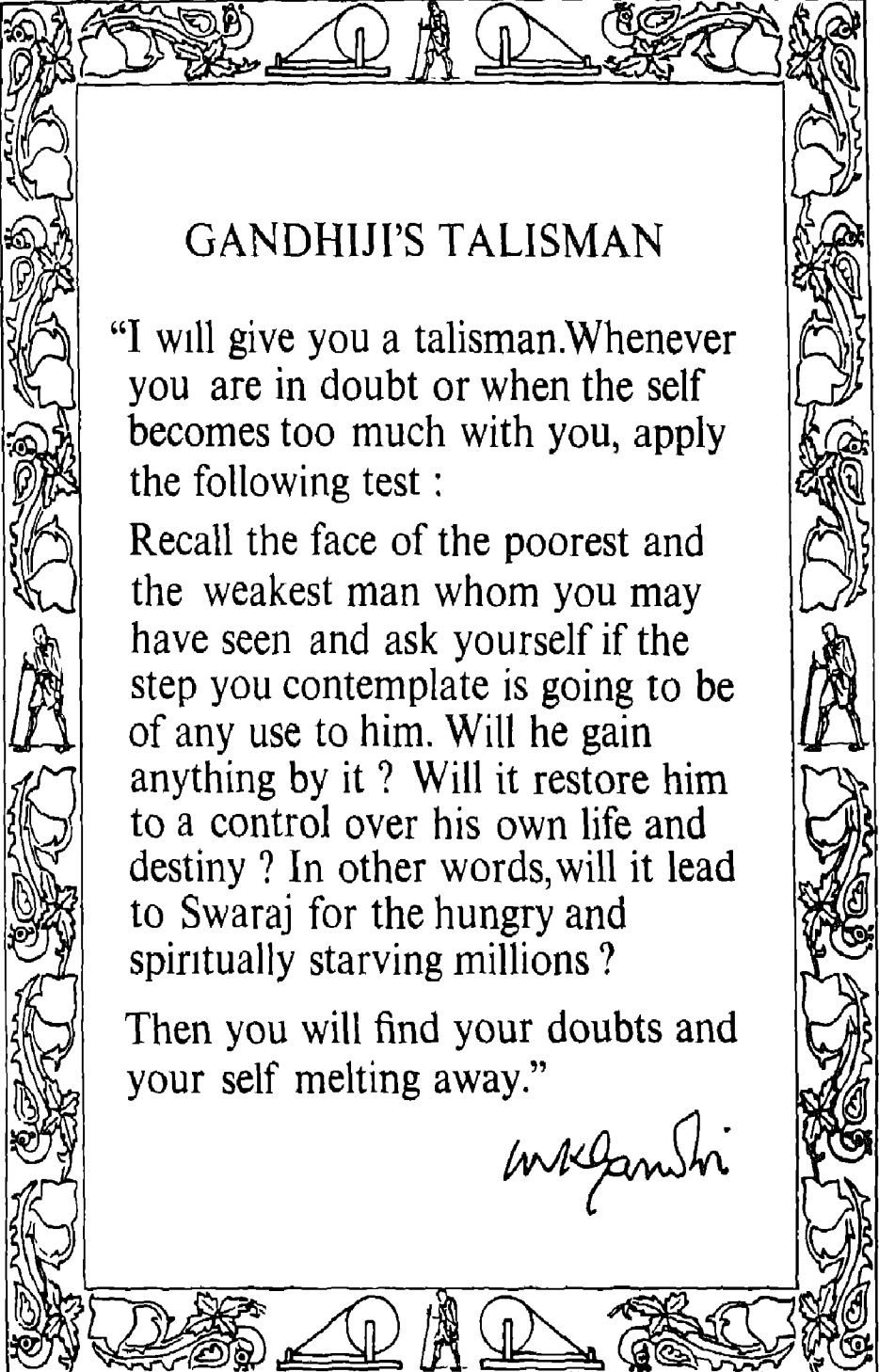
The following experts participated in the workshop conducted by the NCERT. Their participation as contributors or reviewers is gratefully acknowledged.

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Dr S.K. Bhattacharjee



GANDHIJ'S TALISMAN

“I will give you a talisman. Whenever you are in doubt or when the self becomes too much with you, apply the following test :

Recall the face of the poorest and the weakest man whom you may have seen and ask yourself if the step you contemplate is going to be of any use to him. Will he gain anything by it ? Will it restore him to a control over his own life and destiny ? In other words, will it lead to Swaraj for the hungry and spiritually starving millions ?

Then you will find your doubts and your self melting away.”

M.K. Gandhi

About the Manual

Under the programme of Vocationalization of Education about 20 different groups of vocational courses in the area of agriculture have been introduced by fifteen States and Union Territories so far. These courses have been running for the last six or seven years. From the very beginning, the Department of Vocationalization of Education in the NCERT has been working hand in hand with the State organisations concerned, through various programmes organized for State officials, vocational teachers, and others. In fact, by now the Department has conducted on-the-spot studies of vocational programmes in large number of States to find out the merits and demerits of the programmes and to suggest appropriate measures to resolve the problems in 'vocational agriculture education'. These programmes have revealed that there was a great dearth of suitable textual/instructional materials, the need for practical manuals, especially, was urgently felt. The development of instructional materials and the imparting of practical training become even more important when one considers the purpose for which the vocationalization of education programme has been launched. The main aim of the programme is to prepare the pupil for purposeful and gainful employment (wage-earning or self-employment).

The Department constituted a Working Group during the year 1982 to formulate guidelines for developing models for a variety of instructional materials.

Based on the guidelines formulated by the Working Group, Horticulture, which is an important and popular vocational course in agriculture, was selected by the Department for the purpose of development of instructional materials in a phased manner. To begin with, the development of instructional-cum-practical manuals has been taken up.

The contents of Horticulture and similar courses offered by the States and Union Territories under different titles were thoroughly analyzed and it was felt that six manuals would be necessary to cater to the needs of the course. The present manual on Floriculture is one of them. This manual is intended to help both teachers and pupils in the study of different types of ornamental plants and their cultivation, as preparation for this vocation. While developing the manual, care was taken that it should include the maximum number of Activity Units (practical exercises) so that it can fulfil the requirements of the course prescribed by the States and Union Territories in the Horticulture as well as in other vocational courses.

These Activity Units are essential to develop the required vocational skills in the pupils. The manual explains in detail the 'what', 'why', and 'how' of these Units.

In the manual, each Activity Unit has been dealt with under several sub-heads, viz, instructional objectives, relevant information, precautions, materials required, procedure, observations, expected behavioural outcomes and questions.

Before commencing on the actual work under any Activity Unit, the teacher should know what exactly the pupils have to learn and do, and should also assess whether they will be able to do that. Therefore, in the beginning, instructional objectives for the pupils should be framed in behavioural terms by the teacher.

In order to acquaint the pupils with the Activity Unit, the teacher should provide them with the required theoretical knowledge or information relevant to the activity. This will help the pupils to properly understand the Activity Unit. In other words, the 'what' and 'why' parts of the Activity Unit should be explained in advance by the teacher.

Once the pupils have understood the relevant theoretical instructions, the teacher should tell them about the precautions which are to be taken before and during the actual execution of the Activity Unit. This will facilitate smooth working. The 'how' part of the activity should be explained by the teacher in the 'procedure' which the pupils should follow while performing the Activity Unit.

Under the sub-head 'observations', the teacher should tell the pupils what to observe and in view of that, they should observe the situation, take readings, note down the temperature and similar other points under each Unit, these may vary from Unit to Unit. Wherever calculations are required to be done to obtain the results, this should also be indicated under this head or under a separate head.

At the end of the Activity, the pupil will have acquired certain abilities which should be closely related with the instructional objectives formulated for each Activity Unit. These abilities should be listed under the sub-head 'Expected Behavioural Outcomes'. Evaluation should be based on the abilities acquired and it should be done by the teacher concerned.

For evaluating each aspect, the teacher will use a four-point scale, i.e. A, B, C & D, and for each Activity Unit the Grade Point Average can be calculated as indicated below:

Suppose there are four aspects, each carrying equal weightage, and a pupil obtains 2 As, 1 C, and 1 D and if A = 4 points, B = 3, C = 2 and D = 1 point; then based on the grades, the pupil will get 11 points. When the number of points obtained is divided by the total number of aspects examined, it will give the Grade Point Average, which, in this case, is 2.75. The tabular presentation is as under:

<i>Aspects</i>	<i>Weightage</i>	<i>Grades Obtained</i>	<i>TOTAL POINTS (weightage × point— equivalent to grade obtained)</i>	<i>Grade Point Average</i>
1	1	A	$1 \times 4 = 4$	$= 11/4 = 2.75$
2	1	C	$1 \times 2 = 2$	
3	1	D	$1 \times 1 = 1$	
4	1	A	$1 \times 4 = 4$	

At the end of the Activity Unit, some questions relevant to it are also given. The pupils should write the appropriate answers after the completion of the Activity Unit and the teacher should examine these. If required, he should make suitable corrections and give suggestions. However, answers to these questions will not be considered for the purpose of grading.

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Introduction

No other commodity in the world, either natural or man-made, has the unique distinction of bringing joy and happiness to people of all races and ethnic origin as flowers do. Flowers "speak" a language universally understood by people of all countries. They are the best "ambassadors" of goodwill.

Flowers occupied a prominent place in ancient India. The history of flowers in India is as old as its civilization. The first evidence of an ornamental plant, the Pipal (*Ficus religiosa*) comes from a seal from Mohen-jo-daro, of the third millennium B.C. There are references to gardens and flowers in our most revered epics, the *Ramayana* and *Mahabharata*. During the Buddhist period, gardens were laid out around the monasteries and *stupas*, and there were beautiful gardens in Nalanda and Taxila. The ancient kings of India were fond of trees and flowers. The great Emperor Ashok adopted arboriculture, i.e., growing of trees, as one of his state policies. The plays of the ancient poet Kalidas are rich with the names of trees and creepers. The Mughal Emperors laid out beautifully planned gardens which had flowers and trees as well as fountains. These gardens shall delight millions of people who visit them even today.

Flowers symbolize purity, peace, beauty, love and passion. For Indians, especially those who are religious minded, flowers have a much greater significance. A devotee needs flowers every morning for

religious offering to the family deity. Perhaps there is no religion in which flowers are not used for worship. In our society, no social function is complete without the use of flowers. Floral garlands, *gajras* and *venis* are needed not only for marriage ceremonies but have also been used as adornment for the hair by our women throughout the ages. Floral bouquets or flower arrangements also find a pride of place in social gatherings, birthday parties, welcoming a homecoming relative or friend, and honouring dignitaries. The arrival of a new-born is celebrated with flowers, the sick are wished a speedy recovery by offering flowers, while the dead are bid farewell with flowers along with tears of sorrow.

There was a time when flowers were chiefly grown in imperial gardens and public places of worship and pleasure. Today, floriculture has developed into a vast industry in many countries. The trade in cut flowers alone is a multi-million dollars business in Europe, and the Netherlands leads all other European countries in this trade. Even smaller countries like Singapore, Thailand, Malaysia and Sri Lanka in our immediate neighbourhood have developed good business in the export of cut flowers, especially orchids. In Thailand alone the export business of orchids is over 10 million U.S. dollars per year. It is disheartening to note that a large country like India with a varied climate suitable for growing all types of flowers, is not export-

ing any cut flowers

The trade in pot-grown plants too is a very lucrative business in Europe. Here also, India's contribution is almost nil. In recent years, however, efforts have been made to export pot-grown plants.

In spite of the tremendous scope in floriculture, it has always been neglected in favour of the more pressing needs for basic food crops. Besides the export market, there is a huge market for cut flowers and pot-grown ornamental plants in India itself. There is a demand of crores of rupees of cut flowers of different kinds e.g., Jasmines, Tuberose, rose, gladiolus, China asters, crossandra etc. in the five metropolitan cities (e.g., Bangalore, Bombay, Calcutta, Delhi and Madras) of India. The demand for ornamental foliage plants, shrubs, trees etc. is also very good. In a place like Bangalore alone there are scores of nurseries doing good business. A small town like Kalimpong in West Bengal has several nurseries selling bulbs of ornamentals, orchids, cacti and succulents, gerbera, ferns, etc. to different markets in India and abroad.

Besides the above fields, the scope in consultancy service or employment in landscape gardening, especially in the supervisory (middle-level) category is very promising. The various industrial houses in the public and private sectors maintain gardens for their factories and industrial colonies for which they require trained personnel. At present, there is a shortage of such trained personnel.

The vocational training in Floriculture at the Higher Secondary school level, thus, can play an important role in imparting specialized knowledge on the above aspects. The personnel trained in the fields of propagation of ornamental plants, nursery management, production of plants and cut flowers can be profitably engaged,

by encouraging them to start vocations on these lines with loans arranged from the nationalized banks and also under the advice of NABARD (National Agricultural Bank on Agriculture and Rural Development, a branch of the Reserve Bank of India). It is also possible to find gainful employment for these trained personnel in different nurseries and industrial houses.

The role of landscaping parks, home gardens and gardens in educational institutes and planting of trees, in controlling air-pollution cannot be overlooked in the present age. Most of our cities have become over-crowded due to unplanned growth. The increase in vehicular traffic, use of coal ovens (*Chulhas*) in homes, the dust and smoke from factories in the vicinity of the cities are all contributing towards the alarming stage of air-pollution in the environment of our cities. Such pollution is causing a higher incidence of diseases of the respiratory tract, cancer and other ailments. Something has to be done urgently in the cities and the countryside to check this dangerous trend. For this comes the utility of roadside planting of trees and establishment of parks. Parks are considered the lungs of congested cities where people can breathe fresh air, and have a peaceful rest after a day of hard work. Trees are known to cut down noise and air pollution. It is the moral responsibility of the Government to look after these aspects of human welfare, involving land-scaping and tree planting.

The present manual reflecting minimum vocational competencies-based curriculum on Floriculture has been prepared keeping in view all the above aspects. It is expected to be equally useful to both teachers and students of the Horticulture vocational course.

ACTIVITY UNIT 1

Studies on the Seeds of Seasonal Flowers

1.1 Instructional Objectives

The pupil should be able to.

- harvest seeds from fruits;
- identify various types of seeds,
- store the seeds,
- test their viability;
- sow the seeds and raise seedlings

1.2 Relevant Information

What are seeds?

Seeds are fertilized mature ovules each with an embryo which is a rudimentary or minute plant.

What are the parts of a seed?

A seed has three basic parts.

(a) embryo, (b) food storage tissues, and (c) seed coverings.

Why identify seeds?

It is necessary to identify seeds to be able to sow the right seed so as to get the desired plants

How to identify seeds?

Seeds differ in their size, shape, colour and weight. Moreover, seeds vary greatly in the location and structure of embryo and presence of storage tissues. These help in identifying the dif-

ferent kinds of seeds

How many types of seeds are there?

Seeds may be as minute as dust or sand particles or bold and big in size, they may be winged or globose, with hairs or without hairs, seeds may have a smooth surface or a honeycomb surface, seeds may have notches or reticulate covering.

Why collect seeds?

To store them for future use and also to sow them at the proper time to raise more and more plants

How to collect seeds?

Seeds should be collected only from healthy plants, by harvesting the ripe fruits.

When to collect seeds?

Seeds should be mature when collected

Why it is necessary to dry the seeds?

Seeds should be dried to reduce the moisture content to avoid fungus and early germination.

How to dry seeds?

Seed should be dried in the open air, in sunlight or by artificial heat treatment

How to store seeds?

After drying, the seeds should be put in small packets, labelled and stored in air-tight containers

Where to store seeds?

Seed containers should be kept in a cool place which is not damp.

How long can be seeds stored?

It depends on the type; some can be stored only for a few months while some seeds can be stored for years together

What is stratification of seeds?

Some seeds like those of roses have a very hard seed coat, they need softening of the seed coat. This process of softening of the seed coat through moisture is called stratification. Stratification keeps the seed covering moist, which permits quick absorption of moisture when the seeds are planted

What is moist-chilling of seeds?

Seeds are placed between layers of moist sand or soil in boxes (or in the ground) and exposed to chilling temperature, either out of doors or in refrigerators. This method is followed in tree and shrub species of the temperate zone to enhance germination of seeds

What is scarification of seeds?

Scarification is any process of breaking, scratching, or mechanically altering the seed covering to make it permeable to water and gases

Why do some seeds need chilling before sowing?

Some seeds like those of Delphinium, need freezing or chilling before sowing to break dormancy

Why do some seeds need soaking before sowing?

Seeds of the Sweet Pea, Morning Glory, etc., need softening in tepid water to soften the outer covering for good germination

Why is it necessary to sow seeds in seed pans or seed beds?

Primarily for the sake of uniform and high percentage of germination. Seeds of most seasonal flowers are very minute and cannot be sown directly in the field, so they are sown in seed beds or seed pans. The seedlings are then transplanted

Why cannot some seedlings be transplanted?

The seeds of Larkspur, Californian Poppy, Lupins have very sensitive roots which break in transplanting, so these should be sown directly into small pots to avoid transplanting

What is seed viability?

Seed viability is the capacity of the seed to germinate after sowing

Why is it necessary to know seed viability?

This is important in order to know whether the seed will germinate or not.

How to test seed viability?

Before sowing, test the viability by the germination method

What are the factors affecting seed viability during storage?

Moisture content, temperature and storage atmosphere

What are the storage conditions that maintain seed viability?

The storage conditions that maintain seed viability are those which slow down respiration and other metabolic processes without injuring the embryo. The most important conditions for achieving this are reduced moisture content of the seed, reduced storage temperature, and modification of storage atmosphere.

Why is it necessary to purchase seeds of some flowers from nurserymen?

Some of the seasonal flowers like Petunia (Double), Pansies, Double Stock, do not set seed or the seed do not breed true.

What are the seeds which should be purchased from nurserymen?

The seeds of the following seasonal flowers should be purchased from a good nurseryman every year.

Ageratum, China Aster, Carnation (Annual), *Celosia*, *Clarkia*, *Dahlia*—(hybrids), *Linaria*, *Nasturtium* (Double), *Pansy*, *Petunia* (Double), Stock, Zinnias.

Seeds of which seasonal flowers may be collected for use in a garden?

Acroclinum, *Antirrhinum*, *Arctotis*, Balsam, *Brachycome*, Candytuft, *Calendula*, *Coreopsis*, Cosmos, *Chrysanthemum*, *Gailardia*, *Gerbera*, *Hollyhock*, *Linaria*, Marigold, *Nasturtium* (Single), *Petunia*, *Salvia*, *Sapo-*

naria, Shirley Poppy, Sweet Sultan, *Verbana*, *Viola*.

Why is it necessary to treat the seeds with fungicides before sowing?

Seeds should be treated with some fungicide like Captan, Ceresan, etc. before sowing to avoid damping off disease which kills the seedlings.

1.3 Precautions

- Select seeds from healthy plants only
- Air dry the seeds thoroughly before storing
- Store the seeds in air-tight containers
- Clean the seeds and remove all foreign material.
- Store only healthy, undamaged seeds
- Mix seeds of *Petunia*, etc. which are very minute with sand and sow in pans. This will help to get uniform spreading of the seed.
- Do not cover seeds with too much soil after sowing
- Sow the seeds in sterilized soil contained in seed pans or seed beds.
- Sow the seeds of Larkspur, Lupin, Californian Poppy *in situ*.

1.4 Materials Required

- (i) Seed sprouting chambers
- (ii) Hand lens
- (iii) Forceps
- (iv) Digital counter
- (v) Pencil
- (vi) Fungicides like Benlate, Ceresan, Captan, Fytolan etc.
- (vii) Scalpel
- (viii) Vermier calliper

1.5 Procedure

1.5.1 *Harvesting of seeds*

- Select the healthy plant
- Harvest the healthy undamaged and undehisced fruit
- Label the fruit
- Open the fruit/capsule carefully on a sheet of white paper.
- Remove all the seeds.
- Make the seed free from all dirt and unwanted material.

1.5.2 *Drying of seeds*

- Put the seeds in a small tray and keep in an airy place

1.5.3 *Storing of seeds*

- Put dry seeds in envelopes, label them and put them in air-tight containers, store them in a cool place

1.5.4 *Stratification of seeds*

The actual method of stratifying seeds may be varied in several ways. The seeds may be placed in layers of sand, alternating with layers of sand, in a large box that is left open at the top for the addition of more water as needed, or they may be placed in a shallow pit or trench and covered with earth. The one precaution necessary is to place them where there will be sufficient drainage to keep the soil from becoming waterlogged. The soil and sand should be moist but not saturated if the seeds are to remain in it for an extended period of time. Stratification keeps the seed covering moist, which permits easier absorption of moisture when the seeds are planted.

1.5.5 *Scarification of seeds*

This is done in various ways depending upon the nature of seeds like rubbing the seeds on sandpaper, cutting with a file, or cracking the seed covering with a hammer or soaking seeds in concentrated sulphuric acid. Scarification should not proceed to the point at which the seeds are injured.

1.5.6 *Chilling of seeds*

Seeds of *Delphinium* need chilling and should be kept at -4°C for 2-3 days before sowing.

1.5.7 *Viability testing of seeds*

1.5.7a RAG DOLL TEST

- Take a rectangular piece of heavy cloth (flannel, etc.)
- Wet it thoroughly.
- Spread it on a table
- Place seeds on it uniformly (100 seeds)
- Roll it
- Keep it in warm place
- Record the germination percentage after 4-5 days

1.5.7b SEED GERMINATING CHAMBER TEST

- Place seeds in sprouting cups (100 seeds)
- Put the cups in a glass dish full of water
- Put the cups and glass dish in sprout chamber or seed germinator
- Record the percentage of seed germination after 4-5 days

1.5.8 Seed sterilization

- Put seeds in a petri dish
- Mix a small quantity of Cerasan or Benlate fungicide with it. After the seeds are fully covered with fungicide remove them and sow immediately

1.5.9 Soil sterilization

- Take well prepared soil which is ready to use
- Take 2 per cent formalin.
- Mix it well with the soil.
- Cover it with a gunny bag for 48 hours.
- Spread the soil again to dry for about 5 days
- Use it only when there is no smell of formalin

1.6 Observations

The pupil should take and record the following observations.

- (i) Dehiscence of the fruit
- (ii) Number of seeds per fruit
- (iii) Shape of the seed
- (iv) Size of the seed
- (v) Colour of the seed
- (vi) Hairy or non-hairy seed
- (vii) Light or heavy seed
- (viii) Wetness or dryness
- (ix) Mature or immature

Sowing of seeds

Name of the variety

Date of sowing

Date of germination

Date of transplanting

1.7 Expected Behavioural Outcomes

The pupil acquires the ability to

- know different types of seasonal flower seeds,
- know the maturity and ripening time of different seeds;
- know the shape, size and colour of the seeds of different flowers,
- know how to process the seeds after harvest,
- know the importance of viability of seeds;
- differentiate between stratification and chilling,
- sow the seed,
- dress the seed,
- conduct germination test

The teacher should evaluate the pupil for the above abilities

1.8 Questions

- (i) What is the difference between fruit and seed?
- (ii) Are seeds fertilized/non-fertilized ovules?
- (iii) All seeds breed true
(True/False)
- (iv) Hybrid seeds breed true
(True/False)
- (v) All freshly harvested seeds are viable
(True/False)
- (vi) Seeds should be dried in direct sunlight.
(True/False)
- (vii) Seeds should be stored in a humid places.
(True/False)
- (viii) Stratification of seeds means to treat them with chemicals.
(True/False)
- (ix) Chilling is required to enhance quick germination
(True/False)
- (x) The test to know the germination percentage of a seed sample is called _____
- (xi) What is moist chilling of seeds?

- (xii) What is the difference between stratification and scarification?
- (xiii) What are the factors affecting seed viability during storage?
- (xiv) What are the storage conditions that maintain seed viability?

ACTIVITY UNIT 2

Preparation of Seed Bed and Sowing of Important Seasonal Flower Crops

2.1 Instructional Objectives

The pupil should be able to:

- know about the seed bed,
- select the site,
- understand the importance of raising seedlings in the seed bed;
- prepare a seed bed;
- sow the seeds by different methods in the seed bed

2.2 Relevant Information

What is a seed bed?

It is an area where the necessary environmental conditions such as germinating media, plant nutrients, water, temperature and oxygen are provided for the seeds to germinate and grow into healthy seedlings.

Where to prepare a seed bed?

A seed bed may be prepared in a protected area which has proper drainage facilities. The area should have good soil and a perennial water source. Waterlogged areas and shady situations are not suitable for preparing nursery beds. Raised beds, protected from hot and cold blasts of air, are preferable.

Why are seedlings raised in the seed beds?

Most annuals are raised by sowing seeds either in the nursery beds or seed pans or wooden trays. In some cases, where they cannot stand transplanting, they are sown directly in the flower bed or the main field which is referred to as *in situ* sowing.

The young seedlings are delicate and need a lot of care during the early stages of their growth and development. If they are raised in seed beds in a small and compact area, they can be looked after well.

Method of sowing seeds in the seed bed?

The seed beds are prepared as per the requirements and the level of the seed bed is raised in order to facilitate proper drainage and provide protection against flooding and waterlogging.

The seeds are sown either in rows or through broadcasting. The spacing and depth of sowing depend upon the size of the seeds. Generally, they are sown at a depth three times their size. Bold seeds are sown deeper as compared to finer ones. A spacing of 2-5 cm between the rows may be given depending

upon the size of the seed when line sowing is followed

The finer seeds are mixed with sand for proper and uniform distribution. After sowing, the seeds are to be covered with a thin layer of soil. Shade may be provided during summer months but it has to be removed when the seeds start germinating. Watering should be done every day in the evening using a rose can. Over watering is to be avoided. Watering is done to keep the soil just moist.

2.3 Precautions

- Do not select waterlogged areas and shaded situations for preparing nursery beds
- Select a site having porous, sandy loam, fertile soil and perennial water supply for raising nurseries
- See that seeds are free from contamination by weed and other crop seeds
- Use only the true-to-the-type seeds.
- Prepare the soil properly
- Prepare a raised bed in order to facilitate proper drainage, aeration and to protect against waterlogging.
- Water the beds with a rose can only.
- Mix the seeds with sand if they are very small, for uniform distribution while sowing

2.4 Materials Required

- (i) Good germinating medium (sand, leaf mould and sand and soil mixture, vermiculite, etc.)
- (ii) Water source
- (iii) True seeds/quality seeds
- (iv) Shading materials (paddy straw, bamboo nets, polythene sheet, etc.)

- (v) Spade and pickaxe
- (vi) Measuring tape and line rope
- (vii) Marker and wooden pegs
- (viii) Labels
- (ix) Water can with rose.

2.5 Procedure

- Plough or dig the land 2-3 times to about 30 cm deep
- Remove the stones, pebbles, previous crop residues, etc.
- Till and pulverise the soil properly
- Measure the area and mark out the required dimensions for each bed. (A standard size may be 6 m. long, 120 cm. wide and 10 cm high).
- Mix about 15-20 kg of well decomposed organic manure thoroughly with the soil
- Take the pure seeds; weigh them or count them
- Sow the seeds either by broadcasting or in rows in marked lines at the required depth
- Cover them with a thin layer of soil
- Label the seed beds indicating the name of the crop, date of sowing and number or weight of seeds sown
- Provide shade during summer months.
- Water the beds with a rose can every evening and morning depending upon the moisture condition of the soil.
- Take observations periodically (seeds will germinate within a week and the seedlings will be ready for transplanting in about 3-4 weeks when they attain 12-15 cm height. It, however, varies from species to species).
- Remove the shade gradually when the seeds start germinating and ex-

pose the growing seedlings to the sunlight

- Do not let seedlings overgrow in the seed beds.

2.6 Observations

The pupil should take the following observations:

- (i) Name of crop
- (ii) Date of sowing
- (iii) Method of sowing
- (iv) Number/weight of seeds sown
- (v) Size of the seed bed
- (vi) Date of commencement of germination
- (vii) Date of completion of germination
- (viii) Number of seeds germinated
- (ix) Time taken for germination
- (x) Germination percentage =

$$\frac{\text{Number of seeds germinated}}{\text{No. of seeds sown}} \times 100$$

- (xi) Time taken for 2-leaf stage
- (xii) Time taken for 4-leaf stage
- (xiii) Date of transplanting
- (xiv) Estimation of seed viability

2.7 Expected Behavioural Outcomes

The pupil acquires the ability to

- select suitable sites,
- prepare the land;
- prepare the seed bed;
- prepare the seeds for sowing,
- understand the methods of sowing;
- understand after-sowing operations such as covering, providing shade, watering, labelling, etc.

The teacher should evaluate the pupil for the above abilities.

2.8 Questions

- (i) Why should the land be properly tilled and pulverised?
- (ii) What happens if the moisture content is higher in the seed bed?
- (iii) Why should shade be provided during summer?
- (iv) What is broadcasting?
- (v) What is *in situ* sowing?
- (vi) How are the seed beds prepared?
- (vii) What care is to be taken for the raising of seedlings?

ACTIVITY UNIT 3

Identification and Cultivation of Important Seasonal Flowers

3.1 Instructional Objectives

The pupil should be able to

- identify and name different annuals,
- know their growth habits, season of flowering and flower colour;
- know the botanical descriptions of various parts like leaf, stem, flower, etc,
- know their soil and climatic requirements;
- know the cultivation methods and various cultural practices involved;
- know their uses

3.2 Relevant Information

What are seasonal flowers?

Seasonal flowers are generally herbs which complete their life cycle from

seed to seed in one season or within a year. Based on the season of their growth, the annual flowering plants are grouped into summer annuals, rainy season annuals and winter annuals.

The names of important seasonal flowers are given below.

Soil and climatic requirements of annual flower crops

Porous, fairly deep, well-drained, rich, loamy soils are ideally suited for growing seasonal flowers.

Summer annuals require hot weather conditions and may be sown in February-March. Rainy season annuals and winter annuals require low temperature conditions and the seeds may be sown in May-June and September-October respectively.

Important Seasonal Flowers

<i>Botanical Name</i> 1	<i>Common Name</i> 2	<i>Family</i> 3	<i>Season</i> 4
1 <i>Ageratum honstianum</i>	Ageratum	Compositae	Winter
2 <i>Antirrhinum majas</i>	Snap dragon	Seropulariaceae	Winter
3 <i>Brachycome</i> sp	Brachycome	Compositae	Winter
4 <i>Callistephus chinensis</i>	Chinese aster	Compositae	Winter
5. <i>Calendula</i> sp	Pot marigold	Compositae	Winter

1	2	3	4
6 <i>Calliopsis</i> spp	Coreopsis	Compositae	Summer
7 <i>Celosia</i> spp	Cockscomb	Amaranthaceae	Rainy season
8 <i>Senecio cruentus</i>	Cineraria	Compositae	Winter
9 <i>Clarkia</i> spp	Clarkia	Chagraceae	Winter
10 <i>Cleome spinosa</i>	Spider flower	Cappandanceae	Rainy season
11 <i>Cosmos</i> spp.	Mexican aster	Compositae	Summer
12 <i>Delphinium</i> spp	Larkspur	Renunculaceae	Rainy season
13 <i>Diantus</i> spp	Carnations-pinks, Sweet William	Caryophyllaceae	Winter
14 <i>Gaillardia</i> sp	Blanket flower	Compositae	Summer
15 <i>Gomphrena globosa</i>	Globe amaranth, Bachelor's button	Amaranthaceae	Rainy season
16 <i>Helianthus annuus</i>	Sunflower	Compositae	Rainy season
17 <i>Helichrysum</i> spp	Strawflower	Compositae	Rainy season
18 <i>Heliotrope</i> sp	Cherry pie	Boraginae	Rainy season
19 <i>Impatiens</i> spp	Balsam	Balsaminaceae	Rainy season
20 <i>Linaria</i> sp	Toad Flax	Scropulariaceae	Rainy season
21 <i>Linum</i> spp	Linum	Linaceae	Rainy season
22 <i>Lupinus</i> sp	Lupin	Leguminosae	Rainy season
23 <i>Tagetes</i> spp.	Marigold	Compositae	Rainy season
24 <i>Tithonia</i> sp	Mexican sunflower	Compositae	Summer
25 <i>Tropaeolum</i> sp	Nasturtium	Geraniaceae	Rainy season
26 <i>Viola tricolour hortensis</i>	Pansy	Violaceae	Rainy season
27 <i>Petunia</i> spp	Petunia	Selanaceae	Winter
28 <i>Phlox drummondii</i>	Phlox	Polemoniaceae	Winter
29 <i>Pimpinella monoica</i>	Lady's lace	Umbelliferae	Summer
30 <i>Portulaca grandiflora</i>	Portulaca	Portulacaceae	Summer
31. <i>Salvia</i> spp	Salvia	Labiatae	Winter
32 <i>Solidago canadensis</i>	Golden rods	Compositae	Winter
33. <i>Verbena Xhybrida</i>	Verbena	Verbenaceae	Winter
34 <i>Zinnia</i> spp	Zinnia	Compositae	Summer

What are the uses of seasonal flowers?

- (i) Within a short period of time they bring many attractive shades of colour in the garden
- (ii) They are grown in pots and beds for garden decoration
- (iii) Flowers are used for preparing bouquets, and for interior decoration, etc.
- (iv) They are used for hair adornment by ladies and for religious and ceremonial offerings.

3.3 Precautions

- Do not make mistakes while writing the botanical names and families
- Choose appropriate seasonal flowers for different season
- Sow the seasonal flower seeds at the proper time

3.4 Materials Required

- (i) Space for gardening and pot yards
- (ii) Manure, fertilizers, stakes, water source, insecticides, fungicides, tools and implements for cultivation.
- (iii) Plant specimens of different annuals.

3.5 Procedure

- Grow the plants seasonwise in pots and beds
- Select the site and layout for the annual garden.
- Carry on other operations like preparation of beds, transplanting of seedlings, manuring, watering and staking, etc. as per the requirement of different seasonal flowers.
- Take a plant in bloom and observe its various parts like stem, leaf,

flower, etc

- Note the various morphological variations of these parts.
- Give the botanical descriptions of these parts such as leaf size and shape, flower colour, plant height, growth habit, etc
- Draw the figure and label the parts

3.6 Observations

The pupil should take the following observation:

- (i) Botanical name of the crop
- (ii) Family
- (iii) Plant height (dwarf, tall or medium) and spread in cm
- (iv) Habit of growth—erect or branching
- (v) Shape and size of leaf
- (vi) Type of inflorescence
- (vii) Shape and size of flower
- (viii) Flower colour and fragrance
- (ix) Suitability of seasonals for various locations, situations and purposes

3.7 Expected Behavioural Outcomes

The pupil acquires the ability to.

- identify and name the plant,
- describe various parts of the plant;
- understand the seasonal requirements of the crops;
- know the growth habit of the plant;
- understand the various uses of seasonal flowers;
- grow seasonal ornamental plants.

The teacher should evaluate the pupil for the above abilities.

3.8 Questions

- (i) What are the uses of annuals?
- (ii) Name some annuals for cut-

flower production.

(iii) What is interior or indoor decoration?

(iv) Name the annuals seasonwise

(v) Name the annuals heightwise (dwarf, medium and tall).

(vi) Name the annuals suitable for growing in shady location, rockery, carpet bedding and edging plants

(vii) Name same early blooming and late blooming annuals

ACTIVITY UNIT 4

Identification, Description and Uses of Important Shrubs

4.1 Instructional Objectives

The pupil should be able to:

- identify and name different shrubs;
- know their growth habits, season of flowering and flower colour,
- know the botanical descriptions of various parts like leaf, stem, flower, fruit, etc;
- know their soil and climatic requirements,
- know their important uses

4.2 Relevant Information

What are shrubs?

Shrubs are a group of plants of both

flowering and foliage types. Foliage type of shrubs have coloured or attractive leaves. They are woody and hardy in nature and bushy in appearance. In size, they lie between herbs and trees. They live for several years and hence, are perennial in habit. There are evergreen and deciduous types. Evergreens are always green and do not shed their leaves during winter. The deciduous types shed their leaves and do not show any symptom of growth during winter months.

List of flowering and foliage shrubs are given below.

Flowering and Foliage Shrubs

<i>Botanical name</i>	<i>Common name</i>	<i>Family</i>	<i>Season of flowering</i>	<i>Colour of the blossom</i>	<i>Method of propagation</i>
1	2	3	4	5	6
1. <i>Allamanda</i> <i>lucida</i>	Allamanda	Apocynaceae	Hot season	Yellow	Cuttings
2. <i>Arrabidaea</i> <i>magnifica</i>	Bignonia	Bignoniaceae	Hot and rainy season	Purple	Cuttings
3. <i>Artabotrys</i> <i>odoratissimus</i>	Manoranjini	Asclepiadaceae	-do-	Green and yellow	Seeds and layers
4. <i>Azalea</i> spp.	Azalea	Ericaceae	Rainy season	Various colours	Seeds, layers, cuttings

1	2	3	4	5	6
5 <i>Barleria</i> spp	Barleria	Acanthaceae	Spring	Blue, yellow, white	Cuttings
6 <i>Bauhinia</i> spp	Kachanar	Leguminosae	Hot season	White, crimson, yellow	Cuttings
7. <i>Bougainvillea</i> spp	Bougainvillea	Nyctaginaceae	Throughout the year	Various colours	Cuttings and layers
8 <i>Brunfelsia latifolia</i>	Yesterday, today and tomorrow	Solanaceae	Rainy season	Deep lavender changing to white	Cuttings, layers
9 <i>Buddleia</i> spp	Butterfly bush	Loganiaceae	Winter and rainy season	White and purple	Seeds, cuttings
10 <i>Caesalpinia Pulcherrima</i>	Peacock flower	Leguminosae	Rainy season	Yellow and red	Seeds
11 <i>Calliandra</i> spp	Calliandra	Leguminosae	Winter	Pink and crimson	Seeds, cuttings
12. <i>Camellia japonica</i>	Japanese rose	Ternstroemiaceae	Winter	White to crimson	Seeds layers, cuttings, budding
13 <i>Cestrum nocturnum</i>	Night queen	Solanaceae	Twice or thrice a year	Pale white	Seeds, cuttings
14 <i>Clerodendrum</i> spp	Clerodendron	Verbanaceae	Hot season	White, rose, blue	Seeds, cuttings
15 <i>Dombeya</i> spp	Dombeya	Stereuliaceae	Winter	White with rosy tinge	Seeds, cuttings
16. <i>Duranta plumieri</i>	Duranta	Verbanaceae	Hot and rainy season	White, blue	Seeds, cuttings
17. <i>Glaphyria gracilis</i>	Glaphyria	Malphiaceae	Rainy season	Yellow	Seeds
18 <i>Gardenia jasminoides</i>	Cape jasmine	Rubiaceae	Hot season	Creamy white	Cuttings
19 <i>Hamelia patens</i>	Scarlet bush	Rubiaceae	Hot and rainy season	Orange red	Seeds, cuttings
20 <i>Hibiscus</i> spp	Hibiscus	Malvaceae	Hot and rainy season	Various colours	Cuttings, layers
21 <i>Homskioldia sanguinea</i>	Cup and saucer plant	Verbanaceae	Winter	Reddish brown	Cuttings, layers
22 <i>Ixora</i> spp	Ixora	Rubiaceae	Hot and rainy season	White, pink scarlet	Cuttings, layers
23 <i>Jasminum</i> spp	Jasmine	Oleaceae	Hot and rainy season	White, yellow	Cuttings, layers

1	2	3	4	5	6
24 <i>Jatropha multifida</i>	Coral plant	Euphorbiaceae	Rainy season	Scarlet	Seeds, cuttings
25 <i>Lagerstroemia indica</i>	Lagerstroemia	Lythraceae	Hot and rainy season	Rose, pink	Seeds, cuttings
26 <i>Lantana camera</i>	Wild sage	Verbenaceae	Rainy season	White, yellow, orange	Cuttings
27 <i>Lawsonia inervis</i>	Mehndi	Lythraceae	Winter	White, rose, red	Seeds, cuttings
28 <i>Murraya exotica</i>	China box	Rutaceae	Rainy season	White	Cuttings
29. <i>Mussaenda</i> spp	Mussaenda	Rubiaceae	Hot and rainy season	White, yellow crimson, red	Cuttings layers
30 <i>Nerium oleander</i>	Oleander	Apocynaceae	Rainy season	White, cream, pink, red	Cuttings, layers
31 <i>Nyctanthus arbortristis</i>	Parijatha	Oleaceae	Rainy season	White, corolla, Orange, red tube	Seeds, cuttings
32 <i>Pentas</i> spp	Pentas	Rubiaceae	Hot and rainy season	White, purple, red	Cuttings
33 <i>Plumbago</i> spp	Chitramula	Plumbaginaceae	Rainy season	Pale blue, white, pink	Cuttings
34 <i>Poinsettia pulcherrima</i>	Christmas plant	Euphorbiaceae	Winter	Red, yellow pink tracts	Cuttings, layers
35 <i>Punica granatum</i>	Flowering Pomegranate	Myrtaceae	Rainy season	Vermillion	Cuttings, layers
36 <i>Russelia juncea</i>	Weeping Mary	Scrophulariaceae	Rainy season	Bright-coloured	Cuttings
37 <i>Rosa</i> spp	Rose	Rosaceae	Rainy season winter	Various colours	T budding
38 <i>Stachytarpheta mutabilis</i>	Uthirani	Verbanaceae	Rainy season	Scarlet	Seeds, cuttings
39 <i>Tabernaemontana coronaria</i>	Chanderi (Nandibattalu) wax flower	Apocynaceae	Rainy season	White	Cuttings
40 <i>Taeoma stans</i>	Trumpet flower	Bignoniaceae	Rainy season	Yellow	Seeds
41 <i>Thevetia peruviana</i>	Yellow oleander	Apocynaceae	Rainy season	Greenish, yellow	Seeds

Foliage Shrubs

	<i>Botanical Name</i>	<i>Common Name</i>	<i>Family</i>	<i>Method of propagation</i>
1	<i>Acalypha</i> spp	Acalypha, chenille plant	Euphorbiaceae	Cuttings
2	<i>Graptophyllum pictum</i>	Graptophyllum	Acanthaceae	Cuttings
3	<i>Aralia</i> spp	Aralia	Araliaceae	Cuttings
4	<i>Codiaeum</i> spp	Croton	Euphorbiaceae	Cuttings, layers
5	<i>Eranthemum</i> spp	Eranthemum	Acanthaceae	Cuttings
6	<i>Panax</i> spp	Panax	Araliaceae	Cuttings
7	<i>Phyllanthus nivosus</i>	Phyllanthus	Euphorbiaceae	Cuttings
8	<i>Sanchezia nobilis</i>	Sanchezia	Acanthaceae	Cuttings

Soil and climatic requirements

The soil should be organic rich, well-drained and fairly deep. The sub-soil should be free from hard sub-stratum and retentive of moisture. Hard sub-stratum is one which does not allow water to percolate and the root system to grow. There are tropical, sub-tropical and temperate plants. Tropical plants require higher temperature conditions. Temperate plants are grown in cooler climates. As they are perennial and permanent in habit, seasonal variations have little effect on them. Once they are selected and planted in a locality, they remain there for several years.

What are the uses of shrubs?

- (i) They are primarily used for garden decoration and for various types of landscape work.
- (ii) They are used for shrubbery layouts.
- (iii) They are sometimes used as ground cover.
- (iv) They can be used for developing hedges around the garden.

- (v) They can be planted in rows as wind breaks to check the wind velocity.
- (vi) They can be grown in pots and arranged in rows as borders.
- (vii) They can be trained as standards and topiary to resemble some animals and birds.
- (viii) A few shrubs can be used for cut-flower or loose-flower production.
- (ix) They can be used to cover ugly sites like manure pits, potting sheds etc.
- (x) Some are very good as specimen plants in the garden.

4.3 Precautions

- Do not make mistakes while writing the botanical and family names and do proper labelling of all collected shrubs.
- Choose those shrubs first which are most suitable under local condition.

4.4 Materials Required

- (i) Plant specimens of different shrubs
- (ii) A piece of land

4.5 Procedure

- Plant the shrubs and cultivate them properly
- Take a plant and observe its various parts like stem, leaf, flower, fruit, etc,
- Note the various morphological variations of these parts.
- Give the botanical descriptions of these parts such as leaf shape and size, leaf arrangement, type of inflorescence, flower size and colour, plant height and spread, growth habit, etc.
- Draw the figure and label the parts

4.6 Observations

The pupil should take the following observations:

- (i) Botanical name of the plant, and common name (if any)
- (ii) Family
- (iii) Plant height and spread in cm.
- (iv) Habit of growth—erect or branching
- (v) Deciduous or evergreen shrub
- (vi) Flowering or foliage shrub
- (vii) Shape and size of leaf
- (viii) Type of inflorescence
- (ix) Season of flowering
- (x) Shape and size of flowers

- (xi) Flower colour and fragrance
- (xii) Bearing habit—whether terminal or lateral

4.7 Expected Behavioural Outcomes

The pupil acquires the ability to:

- identify and name the plant;
- describe various parts of the plant,
- understand the soil and climatic requirements of plant,
- know the growth habit of the plant,
- understand the various uses of the shrub

The teacher should evaluate the pupil for the above abilities.

4.8 Questions

- (i) How do you define a shrub?
- (ii) What are the uses of shrubs?
- (iii) Make a list of some foliage and flowering shrubs.
- (iv) Differentiate between foliage and flowering shrubs
- (v) Why do deciduous plants shed their leaves during winter months?
- (vi) Group the shrubs according to their height
- (vii) Group the shrubs according to their season of flowering.

ACTIVITY UNIT 5

Planting and Maintenance of Shrubs and Shrubberies

5.1 Instructional Objectives

The pupil should be able to.

- acquire knowledge about the importance and utility of shrubs in a garden,
- classify the shrubs;
- understand general criteria for selection of shrubs, location of shrubbery, camouflaging vacant space in shrubbery;
- learn about the seasons of planting, flowering and methods of maintenance.

5.2 Relevant Information

Shrubs are very important in a garden. It is a must to have shrubs in almost any type of garden.

Importance and Utility

Shrubs are hardy and perennial in habit, hence they require less maintenance, unlike seasonal flowers which require a lot of attention. If proper selection is made, shrubs will produce flowers throughout the year. Trees take a long time to grow, but shrubs may flower within one year after planting.

Shrubs have a number of uses. They

can be planted singly along paths, as a specimen in a lawn, in a shrubbery, in a rock garden (e.g. *Juniperus horizontalis*, *Sanchezia nobilis*, some trailing *Lantana* spp.) or as a hedge (*Duranta plumieri* variegata, *Malpighia glabra*, *Acalyphas*, *Haemelia patens*, *Plumbago capensis* etc.). Many shrubs bear ornamental berries and add beauty to a garden.

Classification

Horticulturally, shrubs are classified as.

- (i) Shrubs with ornamental foliage and beautiful form, e.g. *Crotons*, *Acalyphas*, *Eranthemums*, *Excoccuria bicolor* etc.)
- (ii) Flowering shrubs (e.g. *Gardenias*, *Ixoras*, *Oleander*, *Dombeyas*, *Hibiscus* spp., *Lemonia spectabilis*, etc.)
- (iii) Shrubs with attractive berries (e.g. *Duranta plumieri*, *Cotoneaster*, *Ochna squarrosa*, *Rauwolfia canescens*, etc.)

From a practical point of view, each group is further classified as.

- (a) Shrubs requiring full sun (e.g. *Gardenias*, *Ixoras*, *Tecoma*

- stans*, *Brya ebenus*, *Cassia biflora*, *Duranta plumieri*, etc)
- (b) Shrubs requiring semi-shade in a typical tropical climate (e.g. *Beloperone*, *Excoecaria bicolor*, *Mussaenda philippica*, *Magnolia fuscata*, *Sanchezia nobilis*, *Nandia domestica*, etc)
- (c) Intermediate group—can do well both in sun or partial shade (e.g. *Acalyphas*, *Cerbera fruticosa*, *Daedalacanthus nervosus*, *Eranthemum laxiflorum*, *Lemonia spectabilis*, *Plumbago capensis*, *Thunbergia erecta*, etc)

General criteria for selection

Shrubs for a particular locality are selected depending on several factors like availability of space, sunlight, humidity, temperature, spread and height of the shrub, type (i.e. flowering or foliage), colour of flower, fragrance, etc.

Large shrubs (e.g. *Vitex agnus-castus*, *Memecylon edule*, etc) require more planting space.

Mussaenda philippica cannot tolerate extremes of weather. People may like to plant shrubs with fragrant flowers near bedrooms (e.g. *Cestrum nocturnum* or Night Queen, different species of *Jasminum*, *Cananga kirkii* etc.)

Shrubs like *Ardisia*, *Gardenia*, *Ixora singaporensis* need a humid climate for proper growth and flowering.

Season of planting

In Indian, shrubs are mostly planted during the rainy season. In heavy rainfall areas, the planting may be done at

the far end of the rainy season. In a mild climate like that of Bangalore, planting is possible round the year, except during March-May. In the hills, planting is done either in spring or in the summer season.

Season of flowering

One must observe and study the season of flowering. This knowledge is necessary so that a shrubbery can be planned to produce flowers round the year.

Methods of maintenance

One should know when and how to manure, irrigate, do mulching and prune and train a shrub.

Role of shrubbery in a garden

A shrubbery provides colour and flowers throughout the year. It forms a background for a flower bed. It can be used as screen, instead of a hedge.

Location of shrubbery

It should be located in well-drained soil, and in a sunny situation. Some shrubs can, however, be grown successfully in a shady location which is an added advantage to landscapers.

How to camouflage vacant ground in a shrubbery?

In a newly planted shrubbery, there will be vacant places left in between shrubs. Even in an established shrubbery some vacant places are visible. These should be covered by planting some bulbs (e.g. *Haemanthus multiflorus* or Football lily, *Zephyranthes*, *Hemerocallis fulva* or Day lily, etc.) herbaceous perennials, sub-shrubs or

trailing foliage plants (e.g. *Pileas*, *Zebrina pendula*, perennial *Verbena*, *Zinnia linearis*, etc.).

5.3 Precautions

- Avoid waterlogged soil
- Do not put shade-loving shrubs in full sun or vice versa
- Protect shrubs which are prone to frost injury.
- Protect vulnerable shrubs from mealy bug and scale insect (e.g. *Sophora tomentosa*, *Croton*, *Hibiscus*, etc.)
- Do not overcrowd a shrubbery
- Maintain the sequence of height in a shrubbery (i.e., plant trailing shrubs in front, followed by medium, semi-tall, tall)
- Give an informal shape to a shrubbery. Rectangular or square shapes are not very desirable.
- Label all the shrubs (Botanical name and family)
- Protect susceptible shrubs like *Mussaenda*, *Pentas*, *Phyllanthus nivosus*, *Lxoras*, *Gardenias*, *Manihot*, *Beloperene*, etc. from frost injury either by covering with mats made out of different leaves (straw, *Saccharum munja*) or by growing below frost tolerant trees or shrubs

5.4 Materials Required

- (i) Shrubs of various kinds
- (ii) Pickaxe, spade, *khurpa* or hand-fork, pruning-shears, knife, secateurs, etc
- (iii) Line-rope, rubber-hose, aluminium labels
- (iv) Farmyard manure, bonemeal, fertilizers (super phosphate, urea or ammonium sulphate)
- (v) Planting board

5.5 Procedure

A Planting of shrub

- Dig a pit measuring 45 × 45 × 45 cm
- Mix FYM and bonemeal with the dug-up soil @ 4 kg and 100g, respectively; about 100g or super phosphate may also be added
- Plant the shrub in the middle of the pit, with the help of the planting board, when formal planting, in line, is to be done
- Firm the soil around the shrub by tramping over with feet
- Water liberally after planting. Afterwards, the watering may be done occasionally with intervals of 7-8 days. After the shrubs are established, they may need heavy irrigation once a month. For small shrubs and during the summer, fortnightly irrigation will be necessary. However, irrigation is to be given depending on the need, as there is no set rule for this

B Planting of shrubbery

- Make an informal bed. The size will depend upon the space available. The outline of the bed is marked by bending a rubber-hose in the desired design. Or a thick wet rope may be used to mark the outline
- Dig the bed to a depth of 45 cm. To ensure digging to the desired depth, the dug up soil is kept outside the bed. The top soil should be heaped separately
- Mix FYM @ 4-6 kg per square metre area. Add bonemeal 500g and superphosphate 100g per sq. m area.
- Throw back the dug-up soil in the bed. The top soil should be thrown last

- The shrubs are planted according to height. The dwarf shrubs should be planted in the front. Then the plants of medium height are planted. Tall plants will go in the back rows.
- For a double facing shrubbery, the same sequence is followed from both sides. Thus, the tallest shrubs will remain in the middle.
- Both foliage and flowering type shrubs are to be included.
- Take care to include some shrubs which flower during all seasons.
- Take into consideration the colour scheme while laying out the shrubbery.
- Group shrubs in such a way that no portion remains without flowers for a long time. (For this one has to know the flowering seasons of various shrubs. Fragrant shrubs are very useful in Indian gardens).
- Cover the vacant places with sub-shrubs, bulbs or herbaceous plants (see 5.2.8).

C Maintenance of shrubs and shrubbery

- Learn how to propagate shrubs. Shrubs are to be propagated to replace casualties or for new planting.
- Irrigate at regular intervals.
- Do hoeing with *khurpa* or hoe at monthly intervals.
- Weed, as and when weed growth is observed.
- Pruning has to be done. There is no set rule for pruning. Large shrubs like *Dombeya*, *Vuex*, etc. are to be headed back once in 2-3 years to check their over-growth. Dead, twiggy and over-grown branches are to be removed. Some shrubs flower on the current season's growth,

others on the last year's growth. Those which flower on the current season's growth are to be pruned at the cessation of flowering. Those flowering on last year's growth are pruned immediately after flowering. One good season for pruning is just before the rains in India. During the rains cuttings and layerings are done. This process is a good substitute of pruning for many plants.

- Bad and untimely pruning spoils the shape of the plant, delays or suppresses flowering, reduces the number and size of flowers and shortens the life of the plant. General cleaning and trimming can be done during the monsoon, because this is the season for vegetative growth in most plants. Use secateurs or a pruning knife for small branches and or saw for larger and thicker ones.
- Propagate shrubs, generally during rains. The usual method of propagation is by soft or semi-hardwood leafy cutting, air or ground layering. Some shrubs can be easily propagated by seeds also.

5.6 Expected Behavioural Outcomes

The pupil acquires the ability to:

- know the method of digging pits for shrubs;
- use the planting board;
- know the season of planting;
- apply manure and fertilizers at the proper time, in proper doses;
- identify shrubs and know the flowering season;
- propagate shrubs by the appropriate methods,
- develop a good shrubbery,

5.7 Observations

The pupil should study the shrubs and record the following observations in the given table.

Name of shrub (common, botanical and family names)	Height in cm	Form (e.g. trailing, bushy, tall, pyramidal)	Season of flowering	Colour of flower	Method of propagation (cutting, air or ground layering)	Season of pruning
	2	3	4	5	6	7

— lay out a shrubbery.

The teacher should evaluate the pupil for the above abilities

5.8 Questions

- (i) What should be the size of pits of planting shrubs?
- (ii) Demonstrate by illustration how to plant shrubs in a straight line with planting boards.
- (iii) Classify the following shrubs into foliage and flowering types
Acalypha, *Dombeya*, *Lemonia Spectabilis*, *Excoecaria bicolor*, *Gardenia*
- (iv) Identify the shrubs bearing attractive berries from the following list:
Ixora singaporensis, *Duranta plumieri*, *Eranthemum*, *Con-toneaster*, *Ochna squarrosa*
- (v) Which is the best season for planting shrubs in the plains, in a mild climate and in hill stations in India?
- (vi) Write a note on the pruning of shrubs.
- (vii) What are the points to be considered while laying out a shrubbery?
- (viii) Give a list of fragrant shrubs

ACTIVITY UNIT 6

Identification, Classification and Description of Ornamental Trees

6.1 Instructional Objectives

The pupil should be able to:

- identify the trees,
- classify the trees properly,
- know the various forms of the trees;
- know the growth habit of the trees,
- know the flowering time of the trees;
- know the colour of the flowers of the trees;
- make a study of stems, leaves, etc
- keep a proper record about trees,
- know about planting, care and management of ornamental trees

6.2 Relevant Information

What are ornamental trees?

Ornamental trees are most important perennial hardy plants with a single, straight stem which are grown in private gardens, parks, and on the roadsides, etc, with the object of providing shade and beauty and to create a good landscape

Why is identification essential?

Identification is essential for the proper use of the trees. Without correct identification, we cannot use them

anywhere. Moreover, the identification of plants is educative for the students.

Why botanical names?

The names of the trees vary from locality to locality and many trees are known by more than one name even within a locality or region, creating a great deal of confusion. But a tree has only one botanical name which is known all over the world. Hence, there is no confusion about the identity of any tree. This is the reason why botanical names are preferred over the local names.

What is meant by botanical names?

Botanical names are given to plants by the taxonomists. These names are normally composed of two Latin words. The first denotes the genus and the second the species. The first letter of the genus is always written in a capital letter and is followed by the species name in small letters. The botanical names are always written in italics or underlined e.g. *Cassia fistula*

Botanical classification system

Trees are classified in the following bo-

tanical manner:

- (i) Family—In this, genera of similar morphological features are grouped
- (ii) Genus—This is a group of species in which morphological and genetical similarity is found
- (iii) Species—There may be a number of species under one genus. The species differ from one another botanically

Horticultural classification of trees

This is done according to the habit and nature of trees:

- (i) Foliage trees. Leaves are evergreen and attractive. Flower inconspicuous
- (ii) Flowering trees. Flowers are more attractive than the foliage. Produce flowers in profusion.
- (iii) Deciduous trees. Remain leafless during some parts of the years
- (iv) Shady trees: Foliage is dense, provide shade
- (v) Medicinal trees. Various parts are used for medicinal purposes.

Forms of the trees

Trees are found in various forms, their crown may be

- (i) Round
- (ii) Pyramidal
- (iii) Oval
- (iv) Erect
- (v) Umbrella type
- (vi) Weeping or dropping type

Growth habits

- (i) Quick growing. Grows tall within a short time

- (ii) Slow growing. Grows slowly and takes a long time to become a tree

Flowering time, flower colour and fragrance

Trees flower in different seasons of the year and bear beautiful flowers of various colours. Some trees produce highly fragrant flowers.

6.3 Precautions

- Observe the trees carefully during the flowering season
- Know the family, generic and specific name of the trees and identify them
- Classify the trees as per habit and nature of the plant

6.4 Materials Required

Plant specimens of different trees.

6.5 Procedure

The pupil is required to identify the trees. He should observe and study them and their various parts like the stem, leaf, flower, etc. He should also record his observations of various trees. The students should be taught about planting, care and management of trees in brief.

6.6 Observations

The pupil is required to make thorough observations. These observations should be recorded in tabulated forms—as given below:

Botanical observations

The botanical observations should be recorded in the following manners:

<i>Sl No</i>	<i>Botanical name of the trees</i>	<i>Family</i>	<i>Genus</i>	<i>Species</i>	<i>Local name</i>
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Horticultural observations

<i>Sl No</i>	<i>Botanical name of the trees</i>	<i>Form of crown</i>	<i>Growth habit</i>	<i>Horticultural classification</i>	<i>Flowering period</i>	<i>Flower colour</i>	<i>Local name</i>
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Stem characteristics

- (i) Colour of outer bark
- (ii) Pattern: smooth, furrowed, rough
- (iii) Thickness: to be measured
- (iv) Branching habit

(b) Opposite—two leaves to a node

(c) Whorled—more than two leaves per node

Leaf characteristics

- (i) Shape of leaf blade
 - (a) Linear: narrow, with sides parallel, longer than wide
 - (b) Lanceolate: narrow but widest near base
 - (c) Oblong: longer than broad, ends rounded, sides parallel.
 - (d) Ovate: wide, broadest at base
 - (e) Obovate: relatively wide and broadest at apex.
- (ii) Leaf complexity
 - (a) Simple—with single blade
 - (b) Compound—with divided blade attached to a common stalk
- (iii) Petiole or stalk of blade
 - (a) Petiolate—petiole present
 - (b) Sessile—petiole absent
- (iv) Arrangement
 - (a) Alternate—one leaf to one node

6.7 Expected behavioural Outcomes

The pupil acquires the ability to:

- identify the trees;
- classify the trees in the proper manner;
- study the growth habit and understand the different forms of the trees;
- learn and remember the flowering time and flower colour of the tree;
- keep perfect records of various observations of the trees.

The teacher should evaluate the pupil for the above abilities

6.8 Questions

- (i) Who gives botanical names to the trees?
- (ii) Why are botanical names essential?
- (iii) What is the correct way of writing a botanical name?
- (iv) How can the tree be classified?
- (v) What are the different forms of the tree crown?

- (vi) Name one tree each which flowers during winter, spring, summer and autumn.
- (vii) How do you define a tree?
- (viii) What is the difference between a tree and a shrub?
- (ix) Write the botanical names and common names of five summer flowering trees.
- (x) Write short notes on leaf shape and leaf arrangement.

ACTIVITY UNIT 7

Identification and Detailed Study of Ornamental Climbers

7.1 Instructional Objectives

The pupil should be able to:

- identify climbers;
- classify the climbers properly;
- know the growth habit of climbers,
- know the flowering time of the climbers,
- know flower colours of the climbers,
- make a study of the climbers and keep their proper record,
- know the uses of climbers for different purposes.

7.2 Relevant Information

What are climbers?

Botanically, plants which have the special structure to climb on supports are defined as climbers. Another type of climbing plant grows spirally around another plant or support and does not possess tendrils, rootlets, or thorns, these are known as twiners.

Why is identification essential?

Identification is essential to remember plant by their botanical names, growth habit, etc.

Why botanical names?

Botanical names are known all over the world. The climbers are identified more readily by botanical names rather than local names, which vary from place to place.

What is a botanical name?

A botanical name is the plant's name which consists normally of two Latin words. The first is the genus, and the second the species. The first letter of the genus is always written in a capital letter and is followed by the specific name in small letters. The botanical names are written in italics or underlined e.g., *Bignonia venusta*

Climbers in various groups

The climbers are divided into various groups.

- (i) **TWINERS** These are climbing plants which twine themselves spirally around another plant or some other object
- (ii) **CLIMBERS** Their special organs are modified leaf-stalk, hook-like thorns, etc., which provide the support to the plant
- (iii) **RAMBLERS** These are the plants

which do not succeed in their efforts to climb but manage to spread around; supporting themselves on stems or branches

- (iv) **CREEPERS** The climbers of this group are too weak to rise vertically upwards. They have roots at their nodes for this purpose.
- (v) **TRAILERS** These are similar to creepers, but do not have roots at the nodes.

Botanical classification system

The climbers are studied under the following manner:

- (i) **FAMILY** Under this, genera of similar morphological features are grouped.
- (ii) **GENUS** This is a group of species showing morphological similarity in flowers, fruits, leaves, etc.
- (iii) **SPECIES** The species show very little differences in their morphological characteristics. They come under one genus.

Horticultural classification

The climbers under this are classified according to their nature of their growth, flowering, etc. under the following heads:

- (i) **SHOWY, FREE FLOWERING CLIMBERS**

They flower at certain times of the year. The flowers are very attractive, they may be small or big of various colours.

- (ii) **CLIMBERS FOR FOLIAGE**

These are the climbers which are grown for their beautiful leaves; the flowers in them are of no attractive value. They may be

trained to climb over walls or the trunk of a tree

- (iii) **CLIMBERS WITH SCENTED FLOWERS**

Under this, the climbers which bear scented flowers are included. They are mostly used by amateur gardeners.

- (iv) **CLIMBERS FOR PARTIAL SHADE** These are the climbers which are grown in partial sunshine.

- (v) **LIGHT AND HEAVY CLIMBERS**

In light climbers there is very little growth. They cannot cover a large portion. Light climbers are good for pot culture. The heavy climbers have a heavy amount of growth and can densely cover a great portion of the object, over which they have been supported. The heavy climbers are generally used for screening.

- (vi) **ANNUAL CLIMBERS**

These climbers complete their life cycle within one season or year. They are generally raised from seeds.

Growth habit

- (i) **Quick or fast growing** Grows very tall, within a short time.
- (ii) **Slow growing** Grows slowly and takes time for full development.

Flowering time and flower colour

The climbers in a garden flower in different seasons of the year. They bear beautiful flowers of various colours. Annual climbers flower within one season or so and then die.

7.3 Precautions

— Observe the climbers properly

- Learn and write their botanical names correctly.
- Classify the climbers carefully.
- Keep the records of all the climbers accurately

7.4 Materials Required

Plant specimens of different climbers

7.5 Procedure

- Identify the climbers
- Study them and also their various parts like the leaf, special structure,

stem and flower.

- Collect information about the importance, planting and pruning of climbers.

7.6 Observations

Make thorough observations and prepare a suitable record of the climbers as per tables given below:

Botanical observations

They are recorded in the following table:

Sl. No	Botanical name	Family	Genus	Species	Local name

Horticultural observations

They should be recorded as under,

Sl No	Botanical name	Form of crown	Growth habit	Horticultural classification	Flowering period	Flower colour	Local name

Stem characteristics to be recorded

- (i) Colour: of outer bark
- (ii) Pattern: smooth, rough, furrowed
- (iii) Thickness: to be measured.

Leaf characteristics to be recorded

- (i) Blade: Shape
- (ii) Petiole:
 - (a) Peltate—when petiole is present
 - (b) Sessile—petiole absent
- (iii) Arrangement:

- (a) Alternate—one leaf to a node
- (b) Opposite—two leaves to a node
- (c) Whorled—more than two leaves per node
- (iv) Shape of leaf:
 - (a) Linear—narrow, longer than wide
 - (b) Lanceolate—narrow, but widest near base
 - (c) Oblong—longer than broad, ends rounded, side parallel
 - (d) Ovate—wide and broadest at base

- (e) Obovate—wide and broadest at apex
- (v) Leaf complexity:
 - (a) Simple—with single blade
 - (b) Compound—with divided blades attached to the common stalk.

7.7 Expected Behavioural Outcomes

The pupil acquires the ability to

- identify the climbers;
- classify them properly;
- study the growth habits and understand the different types,
- learn and remember the flowering time and colour of flowers of the climbers;
- record various observations and keep correct records;

— know the various uses of climbers in gardens

The teacher should evaluate the pupil for the above abilities.

7.8 Questions

- (i) Why are botanical names more important than local names?
- (ii) How will you classify climbers?
- (iii) Name some climbers with scented flowers
- (iv) Which climbers can be grown under partial shade?
- (v) What are annual climbers? Name three annual climbers
- (vi) Name some foliage climbers.
- (vii) How do you define climbers?
- (viii) Name some climbers which can be used for pot culture.

ACTIVITY UNIT 8

Identification and Detailed Studies of Bulbous Ornamentals

8.1 Instructional Objectives

The pupil should be able to

- know what bulbous plants are;
- differentiate between bulb, tuber, rhizome and corms;
- identify different bulbous plants;
- plant bulbs in pots and in the field;
- harvest bulbs and store them,
- grow bulbous ornamentals.

8.2 Relevant Information

What is a bulb?

In horticulture, the word bulb includes underground modified stems which are used for propagation e.g. true bulbs, corms, tubers, tuberous roots and rhizomes. The true bulbs, such as *Hyacinthus*, *Narcissus*, *Tulipa* have specialized organs consisting of a short, fleshy, vertical basal plate with growing point or flower primordia at their apex and covered by thick and fleshy scales.

What is a tuber?

It is an underground, short, fleshy

stem, with shorter internodes. The leaves are thin and scaly. The axis is fleshy and swollen and stores the food material (e.g. *Tuberosa*).

What is a rhizome?

It is an underground elongated horizontal stem. It is distinguished from roots by the presence of terminal and lateral buds. (e.g. *Canna*).

What is a corm?

It is a condensed form of rhizome. It is a short, solid, vertical, much swollen underground stem with many buds on the top. (e.g. *Gladiolus*).

What are the types of bulbous ornamental plants?

There are many types of bulbous ornamentals suitable for growing in the plains, hills, sunny and shady locations, in pots or beds. A list of some important bulbs is given below in the table.

Different Types of Bulbous Ornamentals

Natural order family	Botanical Name	Common English name	Colour of flower	Period of flowering	Habitat
1	2	3	4	5	6
Amaryllidaceae	<i>Amaryllis belladonna</i>	Lily	Rose	March-April	Semi-shade
	<i>Cooperanthes</i>	Rain Lily	White-Pink	May-June	Semi-shade
	<i>Crinum</i>	—	White Red Rose	Rains	Sunny
	<i>Haemoanthus</i>	Football lily	Red	Summer	Sunny
	<i>Hippeastrum</i>	Lily	White-crimson	Spring	Sunny
	<i>Narcissus</i>	Nargis	White-yellow fragrant	Spring	Semi-shade
	<i>Nerine</i>	Guernsey lily	Bright crimson	Spring	Sunny
	<i>Polianthes tuberosa</i>	Tube rose	White fragrant	Rains	Warm and moist
Araceae	<i>Alocasia</i>	Snake lily	Spathe striped-purple	Spring	Shade hills
	<i>Caladium</i>	Foliage lily	Variegated leaves	—	Shade
Begoniaceae	<i>Begonia rex</i>	Begonias	Pale rose	Spring	Shady
Cannaceae	<i>Canna indica</i>	Canna	Many colours	throughout year	Sunny
Compositae	<i>Dahlia</i>	Dahlia	Many colours	Spring	Sunny
Iridaceae	<i>Acidanthera bicolor</i>	—	Cream colour petals	Winter	Semi-shade
	<i>Gladiolus</i>	Sword lily	Many colours	Spring	Sunny
	<i>Iris</i>	Iris	Blue	Spring	Sunny
Liliaceae	<i>Gloriosa superba</i>	Climbing lily	Deep orange Red	Rainy	Sunny
	<i>Hyacinthus</i>	Hyacinth	Purple white	Spring	Shade
	<i>Lilium</i>	Lily	Many colours	Spring	Sunny
	<i>Tulipa</i>	Tulip	Red—other colours	Spring	Sunny
Zingiberaceae	<i>Hedychium</i>	Ginger lily	Scarlet	Rains	Semi-shade

Which are the bulbous ornamentals with fragrant flowers?

The following plants have fragrant flowers:

Amaryllis, Crinum, Hymenocallis, Narcissus, Polianthus (Tube rose), *Iris, Ixia, Hosta Hyacinth, Lilium*

What are the bulbous ornamentals grown for their foliage and not for flowers?

The following bulbous ornamentals have attractive leaves.

Alocasia, Arisaema, Caladium, Colocasia, Alpinia, Hedychium, Kaempferia

When do you plant different bulbous ornamentals?

In the plains, the bulbs are planted in autumn, spring or summer depending upon the type. In the hills they are planted in February, after the danger of frost and snow is over.

How deep should a bulb be planted?

As a general rule, the depth of planting should be twice the size of the bulb. Generally, 5-8 cm depth below the soil surface is sufficient.

Do they need staking?

Most bulbous ornamentals do not need any support unless the flower stalk is very long as in the case of the gladiolus.

When to harvest the bulbs?

After flowering, when the leaves dry up, the bulbs are dug out.

How to store the bulbs?

After the harvesting, cut the roots and

top and store in a dark, dry, airy place.

Is it necessary to treat the bulbs with fungicides before storing?

Yes, to avoid rotting and other fungal diseases, the bulbs should be treated with Benlate (0.1% solution), air-dried and then stored.

Can bulbs be grown in pots?

Yes, many of the bulbous ornamental plants can be grown in pots, bowls and are useful for both outdoors and indoors.

How to propagate bulbous ornamental plants?

They can be easily propagated vegetatively. Various structures concerned with vegetative reproduction are as follows:

- | | |
|---------------------|---|
| (a) Offsets | — These are new shoots produced from base. |
| (b) Cormels | — Produced at the base of the corm as in Gladiolus. |
| (c) Fragments | — Parts of bulb—discs, part of tuber or rhizome. |
| (d) Bulbils | — Buds produced in axil of leaves as in lilies. |
| (e) Scales of bulbs | — As in lilies. |

8.3 Precautions

- Never plant the bulbs too deep.
- Note that the field and pots where the bulbs are planted are free from waterlogging.

- Plant the bulbs in raised beds
- Plant the bulb in the centre of the pot.
- Plant bulbs of one type at the same time and depth for uniform sprouting
- Do not store bulbs in damp or very dry places.
- Avoid contact of fertilizers with newly planted bulbs

8.4 Materials Required

- (i) Planting material—bulbs/rhizomes
- (ii) Hand lens
- (iii) Trowels
- (iv) Secateurs
- (v) Fungicide
- (vi) Forceps
- (vii) Pencil
- (viii) Measuring scale

8.5 Procedure

Identification

- Procure the plant material from a reputed nursery
- Study the bulb; note down size, colour and number of lateral buds.
- Plant the bulbs.
- Study the various characteristics like leaf size, flower colour and size, etc for proper identification.

Planting of bulbs

- Plant the bulbs in parallel lines or diagonally in circles keeping appropriate distance and depth, to have uniform flowering.

Harvesting of bulbs

- Lift the bulbs after the leaves dry up
- Cut the roots and the top
- Treat them with fungicide.

- Store them in a dry, dark, airy place.
- Store corms of gladiolus in cold storage or refrigerator (ideal condition), or as mentioned above

8.6 Observations

The pupil should note and record the following observations:

- (i) Name of the plant material
- (ii) Source of the plant material
- (iii) Description of bulb/corm/tuber/rhizome
- (iv) Season of planting
- (v) Season of flowering
- (vi) Proper time of bulb harvest
- (vii) Description of plants and flower

8.7 Expected Behavioural Outcomes

The pupil acquires the ability to.

- differentiate between a bulb, corm, tuber and rhizome;
- know the different types of bulbous ornamentals;
- identify the bulbs,
- know about cultivation of bulbous ornamentals;
- know about the storage of bulbs

The teacher should evaluate the pupil for the above abilities.

8.8 Questions

- (i) What is the difference between a bulb, corm, tuber and rhizome?
- (ii) Gladiolus is a bulb
(True/False)
- (iii) Hyacinth is a tuber.
(True/False)
- (iv) Tuberose is a rhizome.
(True/False)
- (v) Amaryllis is a bulb.
(True/False)

- (vi) Bulbs can be planted in any season (True/False)
- (vii) Bulbs should be planted very deep, irrespective of size (True/False)
- (viii) All bulbous ornamentals have fragrant flowers (True/False)
- (ix) Bulbs should be harvested when all the leaves are dead. (True/False)
- (x) Bulbs should be stored in a damp, humid place. (True/False)
- (xi) Name any two bulbous ornamentals which are grown for their foliage.
- (xii) Name five bulbous ornamentals under the family Amaryllidaceae

ACTIVITY UNIT 9

Identification of Indoor Plants, Their Uses and Basic Requirements

9.1 Instructional Objectives

The pupil should be able to:

- learn about indoor plants and their importance,
- identify indoor plants,
- know about the cultural requirement of indoor plants;
- know about terrariums and Bonsai

- (iii) Palms
- (iv) Cacti and succulents
- (v) Flowering plants (e.g. flowering annuals, herbaceous perennials)
- (vi) Orchids
- (vii) Bromeliads
- (viii) Bonsai

9.2 Relevant Information

What are indoor plants?

All those plants which thrive in the living room of a house under normal conditions of light and humidity are called indoor plants

Why grow indoor plants?

- (i) Indoor plants are never out of season.
- (ii) They are especially useful in cities where people do not have open spaces for gardens
- (iii) They add charm to the beauty of the house and complement the interior setting

What are the different types of indoor plants?

- (i) Foliage plants
- (ii) Ferns

What are indoor foliage plants?

They are plants possessing graceful, green coloured or variegated leaves which may be entire or cut in various shapes and designs.

Which are the important indoor foliage plants?

They are—

Aglaonema, Allocasia, Anthurium, Araucaria (when young), Asparagus, Begonia rex, Caladium, Calathea, Chlorophytum, Coleus, Dieffenbachia, Dracaena, Ficus elastica decora, Fittonia, Hedera, Maranta, Menstera, Peperomia, Philodendron, Pilea, Sansevieria, Scindapsus, Tradescantia, Zebrina pendula.

What are ferns?

They are a group of attractive foliage plants included under 'pteridophytes'. They are hardy, shade loving and do

not require much care. True ferns are represented by the class *Filicineae*. The entire fern plant is known as sporophyte which constitutes leaves, rhizomes or stems and roots.

Which are the important ferns for indoor growing?

They are—

Adiantum (Maiden hair fern)

Asplenium (Bird's nest fern)

Cheilanthes (Silver fern)

Nephrolepis (Boston fern)

Polypodium (Hare's foot fern)

Osmunda regalis (Royal fern)

Platycerium (Stag horn fern)

What are palms?

They are a group of plants with a single stem and large leaves included in the family *Palmae*, suitable for growing in large halls or rooms. The leaves of these plants present a wonderful variety in form and structure.

Which palms are used as indoor plants?

They are—

Howea belmoreana (Dwarf palm)

Neanthe bella (Dwarf palm)

Phoenix roebelinii (Pygmy date palm)

Livistonu chinensis (Table palm)

What are Bromeliads?

They are interesting epiphytic plants with attractive coloured leaves and flowers. They come under the group of succulent plants.

Which are the Bromeliads commonly grown as indoor plants?

They are—

Bilbergia nutans, *Cryptanthus*, *Guzmania*, *Tillandsia*, and *Pitcairnia*

What are cacti and succulents?

They are the group of plants well adopted for unfavourable drought conditions. They store water in their succulent stems and reduce water loss by having waxy skin, coating of wool, bristles or spines. They are grown for the beauty of their flowers and plant shape. They are remarkable for their thick, fleshy leaves or stems, or both. They are distinguished from other plants because of their fantastic habit and whimsical plant form.

What is the difference between cacti and succulents?

All cacti are succulents but all succulents are not cacti, they are distinguished on the basis of their flower characteristics and the presence of areoles.

Some important cacti for indoors

Some of the most important cacti are:

Astrophytum, *Cephalocereus*, *Echinocactus*, *Echinopsis*, *Epiphyllum*, *Mammillaria*, *Notocactus*, *Epiphyllum*, *Mammillaria*, *Notocactus*, *Opuntia*, *Rebutia*, *Zygocactus*.

Some important succulents for indoors

They are

Aloe variegata, *Bryophyllum*, *Crasula*, *Echeveria*, *Euphorbia splendens*, *Gasteria*, *Lithops*, *Pedilanthus*, *Sedum*, *Hoya*, *Glottiphyllum*, *Howorthia*, *Agave americana*, *Adenium obesum*.

What are indoor flowering plants?

These include plants which produce beautiful flowers and can be grown indoors.

Some indoor flowering plants

They are.

Anthurium, *Azalea* (*Rhododendron simsii*), *Begonia* (tuberous and fibrous rooted) *Beloperone*, *Hoya carnosia*, *Gloxinia*, *Impatiens sulcatii*, *Saintpaulia* (African violets), etc

What are orchids?

They are a most beautiful group of plants with different flower shapes, sizes and colours. They come under the family Orchidaceae, which is one of the largest and most diverse of all plant families.

Which are some important orchids?

They are:

Anthurium, *Azalea* (*Rhododendron bium*), *Epidendrum*, *Phalaenopsis*, *Paphiopedilum*, *Milnia*, *Vanda*, etc.

What are Bonsai plants?

These are dwarf adult plants grown in shallow pans. The word Bonsai is formed of two Japanese words, viz. *Bon* (shallow pan) and *Sai* (plant), Bonsai plants add to the decor of drawingrooms

Which are the plants most suited for Bonsai culture?

They are, Conifers (Pines), *Abies*, *Juniperus horizontalis*, *Ficus religiosa*, *F. benghalensis*, *Punica grantatum*, *Fortunella japonica*, *Mangifera indica*, *Jatropha*, etc.

What are terrariums?

These are glass cases like fish aquariums, which are used for keeping different type of plants. Similarly, other

glass containers, big bowls, corbueys etc can also be used for growing small tropical plants. They make an attractive feature for modern drawing rooms

What are the light requirement of indoor plants?

Plants require light of various intensities for their growth. If necessary, artificial light has to be provided. A combination of fluorescent and infra red light is a good substitute for natural light. The amount and duration of such light requirement is different for different plants. A 60 watt bulbs of such light will be sufficient for a 1.5 m long plant area, if hung 1.5 m above the plants

Which indoor plants require more than normal light in the house?

The plants like *Ficus elastica*, *Croton*, *Coleus*, *Geranium*, *Begonia* require more sunlight than other plants.

Which indoor plants require less light?

Plants like, *Aglaonema*, *Dieffenbachia*, *Philodendron*, *Syngonium*, and *Sansevieria* require less light for their normal growth

How frequently should be indoor plants be watered?

This will depend upon climate, type of plant (e.g., Cacti need less watering, but the African violet needs more). Plants need more watering in summer than in the rainy season or winter. Indoor plants should never be over watered.

9.3 Precautions

- Select only very healthy plants for indoor growing.

- Select freshly painted pots and containers; they should not be shoddy
- Never use over or under sized pots for any indoor plant.
- Avoid over watering
- Do not pot epiphytic orchids in compost but in charcoal pieces or tree fern fibre
- Keep ficus (Rubber plant), Croton, Colcus, etc in more light.
- Regularly check your plants for snails, slugs, thrips and other insects.

9.4 Materials Required

- (i) Planting material
- (ii) Pots and containers of various sizes and shapes
- (iii) Secateurs
- (iv) Forceps
- (v) Pencil
- (vi) Florist wires, twine, stakes, etc
- (vii) Measuring scale
- (viii) Room thermometer
- (ix) Hygrometer

9.5 Procedure

- Procure the plant material from a reputed nursery.
- Label all the plants
- Write down the botanical names and common names.
- Study different leaf or stem characteristics and flower characteristics in the case in flowering plants.

9.6 Observations

The pupil should note and record the following observations:

- (i) Name of the plant material
- (ii) Sources of the plant material
- (iii) Shape of the leaf

- (iv) Length/breadth of the leaf
- (v) Colour of the leaf
- (vi) Pattern of variegation in variegated leaves
- (vii) Description of flower in case of flowering plants
- (viii) Room temperature
- (ix) Humidity
- (x) Site of the indoor plant whether near a window, or in a dark corner
- (xi) Incidence of pests and diseases

9.7 Expected Behavioural Outcomes

The pupil acquires the ability to:

- identify different types of indoor plants;
- select different types of indoor plants for different sites in the homes in different seasons;
- Select the right type of pots and containers for various indoor plants;
- protect indoor plants from insect-pests and diseases;
- gain some knowledge about Bonsai and bottle gardens;
- grow indoor plants and know their use.

The teacher should evaluate the pupil for the above abilities

9.8 Questions

- (i) What are the different types of indoor plants?
- (ii) Name a few indoor plants grown for foliage.
- (iii) Name a few indoor plants grown for flowers.
- (iv) Name any five orchids.
- (v) What is the difference between a cactus and a succulent?
- (vi) All cacti are succulents but all succulents are not cacti
(True/False)

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(vii) What are terrariums?

(viii) What are ferns? Name any three
common ferns

(ix) Palms come under the family ..

(x) Orchids come under the family .

(xi) Which plants are most suitable
for Bonsai?

ACTIVITY UNIT 10

Propagation of Ornamental Plants with particular reference to Cuttage, Layerage and Budding

10.1 Instructional Objectives

The pupil should be able to.

- acquire knowledge about the methods of propagation of plants by cuttage, layerage and budding,
- select proper rooting media,
- select an easy and quick method of plant multiplication for commercial purposes

10.2 Relevant Information

What is cuttage?

Cuttage is a method of asexual propagation in which a portion of any vegetative part such as a stem, leaf or root is detached from the parent plant and is cut into parts which are placed under favourable environmental and soil conditions to form roots and shoots, thus, producing a new, independent plant.

What are the different types of cuttage?

They are:

- (i) Stem cuttings
 - (ii) Leaf cuttings
 - (iii) Root cuttings
- (i) *Stem cuttings.* This is one of the most common and easy methods of propagation of plants. It is

divided into three groups based on the nature of the wood used in making the cuttings i.e., hard wood, semi-hard wood, and soft wood

(a) *Hard wood cuttings:* Cuttings are taken from the hard and strong fully mature stems of the previous season's growth e.g. *Bougainvillea*, *Acalypha*, *Hibiscus*, *Roses*, etc.

(b) *Semi-hard wood cuttings.* Cuttings are taken from the semi-hard wood portion of the stem which has partially matured, e.g. *Croton*, *Clerodendron*, *Tecoma*, *Pentas*, etc

(c) *Soft wood cuttings:* Cuttings are taken from the soft succulent portion of the new growth i.e. tip shoots having soft stems. e.g. *Alternanthera*, *Coleus*, *Dahlia*, *Chrysanthemum*, *Geranium*, etc.

(ii) *Leaf cuttings.* Roots are initiated from various parts of a mature leaf which is not too old. Leaf cuttings may be of the following types.

- (a) *Leaf blade cuttings*. New plants develop from the cut pieces of the leaf. Eg *Sanseveria*
 - (b) *Leaf vein cuttings*. New plant develops from the large vein at the base and from the cuts made on veins eg *Begonia*.
 - (c) *Leaf margin cuttings*. New plants arise from foliar 'embryos' in the notches at the margin of the leaf. e g *Bryophyllum*
 - (d) *Leaf bud cuttings*. The cuttings consist of leaf blade, petiole and a short piece of the stem with the attached axillary bud e g *Saintpaulia*, *Peperomia*, etc
- (iii) *Root Cuttings*, Roots are initiated from a detached portion of the root. e.g. *Aralia*, *Lagerstroemia*, etc

What is layerage?

Layerage is the method of propagation in which roots develop on a shoot while it is still attached to the parent plant. The rooted stem is then detached to form a new plant growing on its own roots.

What are the different types of layerage?

These are—

- (i) Air layering
- (ii) Ground layering
- (iii) Serpentine layering

- (i) *Air layering*. In air layering, roots are formed on an aerial shoot. The rooting media consisting of Sphagnum moss or coarse sand and leaf mould is tied on the girdled portion of the air shoots for root initiation. e g *Crotons*, climbing, rambling roses, etc
- (ii) *Ground layering*. In this method, a branch close to the ground is bent carefully and is given a tongue-shaped cut. The tongued portion is buried in the ground carefully and sand-leaf mould mixture is heaped on it for root initiation e g Creepers.
- (iii) *Serpentine layering*: In this method, a long branch, particularly of the creeping type of plants, is alternately covered in the soil and exposed along its length. At the covered portion, tongue layering is done and then, the tongue layered portion is covered by sand and leaf mould mixture.

What is budding?

Budding is a method of grafting wherein only a single bud with a piece of bark is used as scion material. The bud is inserted carefully inside the bark of the root stock.

What are the different types of budding?

There are:—

- (i) 'T' budding
- (ii) Inverted 'T' budding
- (iii) Patch budding
- (iv) Flute budding

Of the four methods of budding,

mentioned above, 'T' budding is widely used for propagating ornamental plants. In this method, the bud in the form of a shield is taken as scion. A 'T' like cut is made on the root stock and the bud is inserted inside the cut and tied with a polythene strip in such a way that only the 'eye bud' is exposed.

10.3 Precautions

(i) *Stem cuttings.*

- Take cuttings from healthy and disease-free plants growing in sunlight.
- Give a slanting and smooth cut just below the basal node
- Do not add any sort of manure to the propagating media. Take coarse sand and leaf mould in equal proportion.
- Take care to maintain polarity.
- In case of hard-wood cuttings treat the cut ends with rooting hormones
- Use porous and light rooting media free from any fungal or other infections

(ii) *Leaf cuttings*

- Select a good mature, healthy leaf
- Choose a shady location with high humidity for rooting

(iii) *Layering*

- Select a healthy shoot.
- The cut or incision should not be too deep
- Wrap the air layered portion carefully so that the moisture from the rooting media does not evaporate.

(iv) *Budding*

- Select healthy and disease free bud wood
- Budding should be done immediately after removing it from the scion plant
- Wrap the budded portion with a polythene strip tightly.
- Care should be taken that water does not enter the cut joints.

10.4 Materials Required

- (i) Double cut secateurs
- (ii) Budding knife
- (iii) Transparent polythene sheet
- (iv) Transparent polythene strips
- (v) Gunny twine (*Sutli*)
- (vi) Earthen pots
- (vii) Coarse sand
- (viii) Leaf mould
- (ix) Sphagnum moss
- (x) Vermiculite
- (xi) Dibbler or wooden stick
- (xii) Water can with rose
- (xiii) Root forming hormone powder (Seradim)

10.5 Procedure

Cuttage

(i) **Stem cuttage**

(a) **HARD WOOD CUTTINGS**

- Select a healthy, vigorous plant growing in sunlight.
- Select a fully matured shoot, with normal internodes growing on the outer side of the plant.
- While removing the leaves see that the buds in the axils of the leaves are not damaged.
- Give a slanting cut just below the basal bud
- Measure the required length of

cutting (about 15 to 22 cm) and give a horizontal cut 1 to 2.50 cm above the top most node. The cutting must have 4 to 5 nodes

- Make propagating media by washing coarse sand or vermiculite
- Pot the mixture.
- Make a hole in the pot with the help of a stick or dibbler
- Dip the cut end of the cutting in root forming hormone
- Insert the cutting in the hole and press the propagating mixture to compact all around the cutting
- Gently irrigate the pot immediately with a rose
- Keep the pot in a shaded place

(b) SEMI-HARD WOOD CUTTINGS

- Select a healthy, vigorous plant grown in sunlight
- Select good healthy shoots growing on the outer side of the plant
- From the selected shoots take out the terminal 10-15 cm portion by giving a horizontal cut just below the basal node
- Remove all the leaves towards the base of the shoots and retain the leaves towards the terminal end
- If the leaves retained are very large, reduce the size by cutting the top half portion. This facilitates close planting of cuttings and also minimizes the loss of water from the cuttings through transpiration
- Plant them as explained under 10.5 (i)(a) (Hard wood cuttings) on p.46

(c) SOFT WOOD CUTTINGS

- Select a healthy and vigorous growing plant
- Select good healthy shoots growing

on the outer side of the plant

- Cut the shoot to a length of 7 to 12 cm by giving a horizontal cut just below a node
- Remove 2 or 3 basal leaves only to facilitate planting
- Plant them in the seed pan having sand or vermiculite as propagating media. The rest of the procedure will be same as mentioned in 10.5.(i)(a) (Hard wood cuttings).

(11) Leaf cuttings

(a) LEAF BLADE CUTTINGS

- Select a healthy, vigorous plant
- Select a healthy and mature leaf from the outer side of the plant.
- Cut it into 5 to 8 cm long pieces horizontally
- Plant them 2.5 to 4 cm deep in a shallow pot having washed sand or vermiculite as propagating media.
- Press the propagating media gently to compact all around the cuttings.
- Carefully irrigate the pot immediately with a fine rose.
- Keep the pot in shade

(b) LEAF VEIN CUTTINGS

- Select a healthy vigorous plant
- Select a healthy and mature leaf from the outside of the plant
- Remove the petiole and give cuts on the alternate veins on the under surface of the leaf near the base.
- Keep the leaf flat on the rooting media of coarse sand and leaf mould or vermiculite in such a way that the cut veins come in contact with rooting media.
- Put some rooting media in heaps on the leaf opposite to the cut veins. This will help in close con-

tact between cut veins and rooting media.

- The rest of the procedure will be the same as mentioned in 10.5.1-ii a (Leaf blade cuttings)

(c) LEAF MARGIN CUTTINGS

- Select a healthy, vigorous plant
- Select a healthy and mature leaf from the outer side of the plant having foliar embryos intact
- Keep the leaf flat on the rooting media of coarse sand and leaf mould.
- Put small pebbles on the surface of the leaf in such a way that the margin comes in contact with the rooting media
- The rest of the procedure will be the same as mentioned in 10.5.1-ii a (Leaf blade cuttings).

(d) LEAF BUD CUTTINGS

- Select a healthy, vigorous plant
- Select a healthy and mature leaf from the outer side of the plant.
- Remove the leaf along with the petiole and a small piece of stem with attached axillary bud
- Plant this petiole deep in a shallow pot having washed sand or vermiculite as propagating media.
- The rest of the procedure will be the same as mentioned in 10.5.1-ii a (Leaf blade cuttings)

(iii) Root cuttings

- Select a healthy, vigorous disease free plant
- Select a good, healthy disease free mature lateral root.

- Cut the root into pieces of 5-10 cm having one or more buds
- Keep the root flat on the rooting media of coarse sand and leaf mould or vermiculite 1 to 1.5 cm deep.
- The rest of the procedure will be the same as mentioned in 10.5.1-ii.a (Leaf bud cuttings)

10.5.2 Layerage

(i) Air layering

- Select a healthy, vigorous and disease free branch on a plant.
- Make a girdle with the budding knife just below a node, 30 to 40 cm from the tip of the shoot. Girdling is made by removing a strip of bark 1 to 2.5 cm wide, completely from around the stem.
- Scrape the exposed surface to remove any trace of phloem or cambium left over
- Cover the girdled portion with moist sphagnum moss. Wrap the polythene sheet above the sphagnum moss and around the girdled portion. Tie with gunny twine (*suthi*). Tying should be perfect so that no moisture from inside can escape.
- Separate the layered shoot from the mother plant when healthy roots are visible through the polythene

(ii) Ground layering

- Select a healthy, vigorous and disease free branch on a plant which is close to the ground.

- Bend it carefully so that it touches the ground easily without breaking the stem
- Mark the portion which touches the ground easily. It should be 20 to 25 cm away from the tip
- On the basal side of the marked portion i.e. towards the ground, cut half way through with a sharp knife just under a node by passing the knife upward, forming a slit of 0.75 to 3.25 cm in length, the length of the slit may vary in different plants. Thus, a “tongue” is formed. Keep it apart from other parts of the stem by inserting a matchstick or crock or any other similar material into the slit.
- Dig that portion of ground where the ‘tongue’ touches it. Fill it with coarse sand and leaf mould mixture.
- Put a stone on it to keep the layered portion in position.
- Irrigate it immediately. Watering may be done whenever required.
- Keep a watch for 1½ to 2 months, and check for initiation of roots by removing soil mixture.
- Separate the layered shoot from the mother plant when sufficient roots have formed.
- Leave 2 buds and give a second treatment. Repeat the same as many times as possible, depending upon the length of the branch and its flexibility.
- Cover all the treated area under the soil, exposing the tip of the shoot and the buds left in between two treatments and keep a weight on all covered heaps of soil.
- Irrigate the buried portion regularly.
- Observe for 1½ to 2 months and check for initiation of roots by removing soil mixture.
- Separate the layered shoots when the initiation of roots is complete.

10.5.3 ‘T’ Budding

- Select a healthy, vigorous disease free stock plant
 - Select a place with smooth bark, close to the ground.
 - Give a vertical cut with a budding knife to a length of about 2.5 to 3.75 cm on root stock and only up to bark depth.
 - At the top of this vertical cut, give another horizontal cut. These two cuts form the letter ‘T’. The vertical cut should be at the centre of the horizontal cut.
 - Lift the bark pieces on either side of the vertical cut for insertion of the bud.
 - Select the disease free bud stick having good buds.
 - Start slicing cut about 1.0 cm below the bud and continuing it upward under the bud, to about 2.5 cm above the bud.
 - Give another horizontal cut
- (iii) **Serpentine layering**
- Select a healthy, vigorous and disease free long branch on the plant which is very close to the ground.
 - Layer it by tongue layering 15 to 30 cm back from the tip of the branch as described above in 10.5.2. ii.

- about 1.0 cm above the bud
- Remove the shield of bark along with the bud from the bud stick
- Remove the inside wood from the bud
- Insert the shield of bark with bud under the two raised flaps of the root stock bark until its upper horizontal cut matches with the vertical cut on the root stock.
- Wrap the bud portion with transparent polythene strip tightly exposing the bud

10.6 Observations

The pupil should record the following observations.

- (i) Name of the plant/variety
- (ii) Type of operation (stem cutting/leaf cutting/root cutting/layering/budding)
- (iii) Date of operation
- (iv) Percentage of success
- (v) Nature of the soil mixture used/media for planting cutting

10.7 Expected Behavioural Outcomes

- The pupil acquires the ability to
- select the correct type and size of stem, leaf and root cutting for

- rooting of particular plant species;
- select the correct type of rooting media for particular types of stem, root and leaf cuttings;
- propagate plants by vegetative means, like cutting, layering and budding

The teacher should evaluate the pupil for the above abilities.

10.8 Questions

- (i) What is cuttage?
- (ii) Name the different types of stem cuttings
- (iii) How will you proceed to propagate different types of cuttings?
- (iv) Name three types of leaf cuttings
- (v) How will you proceed to propagate different types of leaf cuttings?
- (vi) What is layerage?
- (vii) Name three types of layering.
- (viii) How does layerage differ from cuttage?
- (ix) What is budding?
- (x) Name four different types of budding and describe the method of 'T' budding in detail

ACTIVITY UNIT 11

Pot Culture of Ornamental Plants

11.1 Instructional Objectives

The pupil should be able to:

- know different types of pots,
- prepare various pot compost mixtures for different plants;
- remove the plant from the pot,
- repot the plant;
- transplant safely without damaging the plant;
- know about pot composts, merits and demerits of different pot composts.

11.2 Relevant Information

What is potting?

Potting means filling of a particular type of soil compost mixture in a particular pot for growing a particular plant

Why are plants grown in pots?

When there is no space for growing plants in the ground, plants are grown in pots. Moreover, ornamental foliage plants and some other indoor plants are normally grown in pots. Plants grown in pots are easy to handle and can be used for decorating any place. Those plants which need special care can be grown in pots and

can be better supervised.

Types of pots

- (i) **EARTHEN POTS** These are made of burnt porous clay and are available in various shapes and sizes. Earthen pots are widely used as being porous. They allow exchange of gas and draining out of excess moisture.
- (ii) **METALLIC POTS** These are made of brass, copper and become hot in a warm climate. Being costly, they are seldom used. Sometimes, they are used for keeping attractive plants in the drawingroom or some special corner in the garden.
- (iii) **PLASTIC POTS**. These are light in weight, durable and are suitable for growing different kinds of plants up to a certain age. Plastic pots are largely used nowadays in developed countries.
- (iv) **WOODEN POTS**. These are painted with water-proof paint on both sides. These are not of much use for any practical purpose.
- (v) **CEMENT POTS** These are heavy and durable. They can accommo-

date big plants for several years

What is repotting?

Repotting means transferring a potted plant from one pot to another having fresh soil compost mixture. It is done when roots are beginning an active growth and not when they are dormant or resting.

Why is repotting done?

- (i) When the roots of a growing plant are over-crowded in a pot, it is transferred to a new, bigger pot.
- (ii) When the soil of a pot has got old and turned sour, the plant is taken out and the earthen ball is broken without disturbing the roots. The roots are pruned and then the plant is repotted in fresh soil compost mixture.

11.3 Precautions

- Always use clean pots and crocks otherwise fungus/bacteria of the old, dirty pots will infect the new plant
- Use pots of the right size for potting and repotting of plants. Over-sized pots should never be used
- Provide effective drainage to pot plants by making a hole in the base and covering it suitably with crocks.
- Always use the right soil compost mixture for a particular plant.
- Moisten the soil compost mixture moderately before filling it in the pot
- Do not put the plant too deep or too shallow in the pot. Shallow planting may result in injury to the roots of the plant by wind, etc

- Put the plants in bigger pots if they are over-grown
- Break the clayey earth ball of the plant carefully and spread the roots evenly on soil compost mixture without damaging the roots
- Irrigate the pot gently. Avoid over irrigation
- To know whether a potted plant needs irrigation, tap the side of the pot with a wooden hammer or rafter. If the soil is moist it will give a dull sound and if the soil is dry, metallic kind of sound is produced

11.4 Materials Required

- (i) Earthen pot or any other pot to be used.
- (ii) Crocks (broken pieces of earthen pots).
- (iii) Coconut fibre in pieces/dried leaves for clearing the pots
- (iv) Spade
- (v) Basket
- (vi) Watering can with a fine rose
- (vii) Soil mixture ingredients
 - (a) Cowdung manure
 - (b) Loam
 - (c) Leaf mould
 - (d) Charcoal
 - (e) Lime rubbish
 - (f) Sphagnum moss (chopped)
 - (g) Powdered charcoal
 - (h) Brick pieces
 - (i) Powdered brick
 - (j) Tank silt

11.5 Procedure

- (i) *Potting*
 - Soak the fresh earthen pots in water for two hours. If old earthen pots are to be potted, clean the pot

and wash it thoroughly

- Make a drainage hole in the bottom of the pot. The size of the hole will be in proportion to the pot
- Cover the hole with clean crocks (a piece of broken earthen pot). Put the concave or hollow side towards the hole. For rapid drainage, put more crocks over these. About 1/3rd of the depth of the pot is filled with drainage materials (crocks, broken bricks, sand, fibre, etc.)
- Put a layer of 2 to 5 cm (according to the size of pot) of coarse sand as this will help in preventing the soil compost mixture from getting washed down
- Mix thoroughly the suitable soil compost mixture with the help of a spade and moisten the soil moderately (See Table 1)
- Fill the pot up to half the depth of the pot with prepared soil compost mixture
- Hold the plant in the centre of the pot and spread the roots evenly in all directions without damaging the roots.
- Put the soil compost mixture over the roots and press firmly, and fill the pot till sufficient space (1 to 5 cm) is left on top for holding water
- Irrigate the plant gently with a fine rose. Avoid over irrigation
- Keep the potted plant in the shade till the plant is established
- Expose the pot to the sun gradually
- Plants should be watered only when the soil becomes dry and the plant shows wilting symptoms
- Apply liquid manure once every 15 days. This should be stopped when

the plant is in dormant condition,

(ii) *Repotting*

- Water the potted plant thoroughly
- After an hour, gently tap the outside of the pot with a wooden hammer or rafter to loosen the earthen ball
- Take out the earthen ball from the pot by carefully inverting the pot. While doing so, the ball of earth should be supported by the fingers of the left hand. The plant should not be damaged.
- Remove all the crocks under the ball of earth. Also remove all the superfluous and old soil gently.
- Cut cleanly the decayed and superfluous roots with a sharp knife
- Draw out the thick roots carefully from the ball of earth

The rest of the procedure of repotting will be the same as described under "potting"

11.6 Observations

The pupil should observe

- whether water is properly draining out through the drainage hole. Repot and correct the drainage.
- the roots are coming up to the surface of the pot. It means the plant has become pot bounded. Repot the plant.
- whether the plant has overgrown. It is time for division of plants and repotting
- for stunted growth. Apply nutrient to pots
- the freshly transplanted plant carefully which should overcome the transplanting shock

11.7 Expected Behavioural Outcomes

- The pupil acquires the ability to:
- select different sizes of pots for different plants,
 - prepare different soil compost mixtures for different plants,
 - provide drainage to the potted plant,
 - transfer the plant from one pot to another,
 - prune the roots of the pot bounded plant.
 - irrigate the pot plant at the right time
- The teacher should evaluate the pupil for the above abilities

11.8 Questions

- (i) What is potting?
- (ii) Why are plants grown in pots?
- (iii) Write in detail about the various types of pots.
- (iv) What is repotting?
- (v) Why is repotting necessary?
- (vi) What precautions will you take before potting and repotting?
- (vii) Write in detail about the procedure for potting and repotting of plants
- (viii) What should be the quality of a good pot compost?
- (ix) Suggest a suitable pot mixture for a rose and palm plant
- (x) What are the materials generally used as pot compost?

TABLE I
Soil compost mixture in parts for growing plants in pots

Sl. No	Plants	Cow dung manure	Loam	Sand	Leaf Mould	Char coal	Lime rubbish	Brick Pieces	Powd-ered brick	Tank silt	Pro-duced charcoal
1	2	3	4	5	6	7	8	9	10	11	12
1	Seasonal flowering plants	3	1	1 5	—	—	—	—	—	—	—
2	Coleus and soft wooded plants like Geranium, violet, etc	6	4	3	2	—	—	—	—	—	—
3	Bulbs, plants like Dahlia, etc	2	3	2	2	0 25	—	—	—	—	—
4	Roses	6	6	3	—	—	—	—	—	—	—
5	Crotons	4	4	3	2	—	1	—	—	—	—
6	Palms	2	5	3	4	—	—	—	—	—	—
7	Ferns	2	2	3	4	0 50	1	1	—	—	—
8	Begonias	4	4	3	4	1	1	—	—	—	—
9	Caladiums	4	4	3	4	0 50	1	—	—	—	—
10	Draceanas	2	2	3	4	0 50	—	—	—	—	—
11	Dieffengachia and similar tropical foliage plants	1	1	2	5	0 50	—	—	0 25	—	—
12	Anthurum, Philodendron, etc	1	—	2	5	1	—	—	1	—	—

1	2	3	4	5	6	7	8	9	10	11	12
13	Orchids—epiphytic	—	—	—	—	1	—	2	—	1	—
14	Succulents	1	2	1	2	1	—	—	—	—	—
15	Shrubs and creepers	4	5	4	2	—	—	—	—	—	—
16	Fruit plants	2	4	2	—	—	—	—	—	—	—
17	Soft and hard wood cuttings	—	1.50	1	1	—	—	—	—	—	—
18	Seed sowing	—	1.50	1.50	3	—	—	—	—	—	0.50

11.9 Plants which can be grown in pots

Annuals

All sorts of annuals can be grown in pots. They may be grown in 25 to 30 cm pots.

Bulbous plants

The pot size will be in proportion to height of the plant. However 25 to 30 cm pots will accommodate most bulbous plants.

Shrubs and other plants

Most shrubs like Acalyphs, Bougainvilleas, Crotons, Roses, Barleria, Aralia, Crossandra, Eranthemum, Graptophyllum, Pentas, Mussaenda, Duranta, Graptophyllum, Pentas,

Mussaenda, Duranta, Excocaria, Haemelia, Malpighia, Jasminum, Sambac, Ixora, Coleus, Dracaena, Russellia, Cycus, Palms, Achania, Allamada, etc.

Indoor plants

All plant species suitable for growing inside the house are grown in pots of various shapes and sizes. The size of the pot will be in proportion to the growth of the plant e.g. Ferns, Cacti, and Succulents, Pilea, Caladium, Maranta, Chlorophytum, Money plant, Iresine, Philodendron, Aglaonoma, Peperomia, Diffenbachia, Ficus elastica, Aglaonema, Begonia, Peopromia, Asparagus, Calathea, Aspidistra, Bromeliads, Aspidistra lurida.

ACTIVITY UNIT 12

Lawn—Its Establishment and Maintenance

12.1 Instructional Objectives

- The pupil should be able to
- select the proper site,
 - level and trench the soil,
 - provide effective drainage,
 - manure the soil,
 - select the grass,
 - dibble the rooted and unrooted cuttings of grass,
 - irrigate the lawn;
 - mow and maintain the lawn.

12.2 Relevant Information

What is a lawn?

A lawn is a ground covered with perennial fine grass which persists under rather continuous close mowing and requires proper maintenance. It is one of the most important features of a garden. A lawn is also known as the heart of a garden. It gives pleasure to people and adds charm to the surroundings. A good lawn can be raised on sandy loam soil rich in organic matter. The sub-soil should be retentive of moisture and must provide good drainage.

12.3 Precautions

- Select the appropriate site for a lawn
- Avoid black cotton soil as one can never raise a good lawn on such soil.
- Black cotton soil cracks during summer and become muddy and unworkable during the rainy season.
- Black cotton soil may be replaced up to 30 cm depth by well drained, sandy loam soil
- Raise the lawn 5 to 10 cm above the ground level for providing effective and easy drainage of excess water.
- Select the proper grass species for the lawn
- Be sure about levelling and grading

12.4 Materials Required

- (i) Pickaxe
- (ii) Spade
- (iii) Baskets
- (iv) Well rotted cowdung manure
- (v) White sand

- (vi) Rooted and unrooted cuttings of grass
- (vii) Bonemeal or superphosphate
- (viii) Ammonium sulphate/urea
- (ix) Rubberised hose pipe
- (x) Wooden plank
- (xi) Spirit level
- (xii) Rake
- (xiii) Hoe
- (xiv) Lawn-mower

12.5 Procedure

- Trench the ground in May or June Dig up to 45 cm depth.
- Break the clods and remove roots of weeds and hard stones with the help of a rake.
- Apply well rotted cowdung manure at the rate of half-ton per 100 sq metres and mix thoroughly
- Turn the soil-manure mixture for two to three weeks and keep it exposed to the sun, to kill all weeds
- Flood the soil-manure mixture for two to three weeks with water over and over again Remove the weeds that will germinate during this period
- Spread this soil-manure mixture on the area with the help of a spade so that it is 5 to 10 cm above the ground level This will provide easy and effective drainage Good drainage provides a suitable physical condition of the soil for proper development of roots. Water standing in pockets causes injury.
- Level the land with the help of a wooden plank and use spirit level to check the level and give a gradual slope to drawing the water away from the nearby buildings
- Apply superphosphate or bone-

meal at 8 kg per 100 sq metres in soil-manure mixture and mix well into the top layer of the soil by hoeing and racking

(i) *Raising a lawn through seed (Seed Method)*

Mix 250 gm seeds of *Doob* grass (*Cynodon dactylon*) with 4 to 5 kg of finely sifted soil so as to give even distribution and spread it evenly in 100 sq metre prepared area of soil-manure mixture. Rake the soil slightly for covering the seeds. Sprinkle water daily with a fine rose.

(ii) *Raising a lawn through rooted or unrooted cuttings (Dibbling Method)*

- Dibble rooted or unrooted cuttings of *Doob* grass (*Cynodon dactylon*) 5 cm apart on prepared area of soil-manure mixture. Complete the lawn planting.
- Pass a very light roller over the surface and irrigate lightly at short intervals.
- Irrigate the lawn thoroughly and frequently through a rubberised hose pipe, in dry, hot months i.e., after every 2 to 3 days in hot, dry weather and 8 to 15 days in winter
- Mow the lawn frequently i.e., every 8 to 10 days. Do not allow the grass to produce seed stocks Irrigate the lawn thoroughly after every mowing
- Pass a medium to heavy roller once a month after mowing and irrigate the lawn thoroughly.
- Observe the lawn for weeds frequently Whenever weeds are seen, uproot them along with the roots.

- Proper drainage and aeration should be ensured.
- Apply well rotted cowdung manure i.e. nearly 2.5 cm thick on lawn surface twice a year i.e. once in June and the second time in January. This may be done after lawn mowing. Irrigation should be done after manure application
- Apply 6 kg of fertilizer mixture i.e. Ammonium sulphate 12 parts: Superphosphate 3 parts: Potassium sulphate 1 part to every 100 sq metres area, thrice a year i.e. during February, June and November. Fertilizer mixture may be broadcast after lawn mowing. Irrigate the lawn after fertilizer application.
- Apply 5 kg of quick-lime to every 100 sq metres of only that lawn which has turned acidic. When the slimy growth of algae on the lawn grass is observed, it is an indication that the lawn soil has become acidic. Irrigate the lawn immediately after quick-lime application.

12.6 Observations

The pupil should undertake the following observations in the establishment of a lawn:

- (i) Level of the lawn surface.
- (ii) Drainage of the lawn
- (iii) Surface look of the lawn before and after mowing.
- (iv) Type and number of weeds in the lawn.

- (v) Presence of earthworms or ants on the lawn.
- (vi) Colour of the grass before and after application of nitrogen

12.7 Expected Behavioural Outcomes

The pupil acquires the ability to

- select the site for a lawn,
- select the suitable method for lawn establishment;
- establish and maintain lawns

The teacher should evaluate the pupil for the above abilities

12.8 Questions

- (i) What is a lawn?
- (ii) What points will you consider while selecting a site for a lawn?
- (iii) Name various points in the preparation of a lawn
- (iv) Write the dose and time of application of manure and fertilizers for maintenance of a lawn
- (v) What is the indication of acidic lawn soil?
- (vi) How is the acidity of such lawn soil corrected?
- (vii) Describe the different methods of planting lawn grass.
- (viii) What is the main purpose of mowing?
- (ix) What should be the height of the cut in mowing?
- (x) What is the effect of rolling on lawn grass?
- (xi) How can you ensure proper drainage and aeration in the lawn surface?

ACTIVITY UNIT 13

Commercial Cultivation of Roses

13.1 Instructional Objectives

The pupil should be able to:

- select the site for rose cultivation,
- know the various types of roses;
- know the important commercial varieties of roses;
- plant and prune roses;
- undertake various cultivation operations of roses;
- know the export potential of roses

13.2 Relevant Information

Why should roses be planted commercially?

There is a great demand for rose cut flowers in our country and in foreign markets. Therefore, it is profitable to grow roses for cut flower production and also for the production of plants

Classes of roses

There are various classes of garden roses. Among them, six different types of roses are commercially grown in our gardens

(a) THE HYBRID TEA

There are long flowered types. Normally, only one flower is borne on a stem. The flowers also have a long stem. The examples are:

- (i) Baccara (bright geranium red

flowers)

- (ii) Christian Dior (velvety red flowers)
- (iii) Crimson Glory (velvety crimson)
- (iv) Golden Girl (golden yellow flowers)
- (v) Virgo (pure white flowers)

(b) THE FLORIBUNDA

In this, the flowers are found in clusters, not as single flowers as in the Hybrid Tea. The cultivars under this may be tall and free growing. Examples are:

- (i) All Gold (yellow)
- (ii) Amber Light (orange yellow)
- (iii) Delhi Prince (deep pink flowers)
- (iv) Golden Rain (golden yellow flowers)
- (v) Golden Lace (golden yellow flowers)
- (vi) Queen Elizabeth (pink).

(c) THE DWARF POLYANTHA

They produce enormous clusters of small flowers and bloom for several months. They grow well in pots and beds. There are some valuable roses in this group. Examples are:

- (i) Cameo (salmon pink with orange shading)

- (ii) Echo (pink and white)
- (iii) Ideal (velvety crimson)

(d) THE MINIATURE

These are very popular baby roses with small leaves and flowers. They are grown from cuttings and displayed in pots and beds. Examples are

- (i) Baby Gold Star (golden yellow flowers)
- (ii) Coraline (red orange bloom)
- (iii) Pixie (white with faint pink flowers)

(e) THE RAMBLER

The flowers in ramblers grow in clusters and the leaves are usually pale green. There is only one flush of bloom during the year which lasts for several weeks. Examples are

- (i) American Pillars (carmine pink with white and golden stamen)
- (ii) Excelsa (light crimson)
- (iii) Dorothy Perkins (rose pink flowers)

(f) THE CLIMBERS

There are various types of climbers found in our gardens. The flowers come singly or in twos or threes. The flowering may continue over the season. Examples are

- (i) Marechal Neil (golden yellow flowers)
- (ii) Lamarque (white)
- (iii) Casino (light yellow)
- (iv) Golden Shower (yellow)

Rose cultivars of commercial importance,

The rose cultivars which can be cultivated on a commercial scale are

- (i) Christian Dior (red)

- (ii) Happiness (red)
- (iii) King's Ramsom (yellow)
- (iv) Kiss of Fire (pink)
- (v) Super Star (coral orange, vermillion)
- (vi) Papa Moilland (red)
- (vii) Queen Elizabeth (pink)
- (viii) Montezuma (coral red)

The varieties which are accepted in European markets for export are Mercedes, Illona, Sonia, Golden Times, etc

Characteristics of commercially important roses

- (i) The rose cultivars should bear strong pointed flower buds
- (ii) The flower buds of the cultivars should not be too large
- (iii) The flowers and buds of the cultivars should be firm enough to withstand transportation.
- (iv) The blooms of the cultivars should have long cut flower life or vase life
- (v) The flower buds should open slowly.
- (vi) The flower stem should be long and sturdy
- (vii) The flower colour of the cultivar should be pleasing, attractive

Export possibilities

A large part of Europe remains snow-bound in winter. At that time flowers are produced in temperature-controlled greenhouses. As a result, the cost of production becomes high in European countries. Roses grown under plastic, fibre-glass or glass greenhouses only are available for sale in the European market. Since in our country the winter is not so severe and labour is cheap, it is possible to pro-

duce roses with lower cost of production. Moreover, roses grow very well in different parts of our country during the winter months. Hence, the possibility of exporting rose cut flowers to Europe is very bright if quality roses can be produced.

Selection of site for roses

The site for commercial cultivation should be selected carefully. It should be near the airport or the local market. A sheltered portion where plants are protected from hot and cold wind should be preferred. The soil should be free from rocks and small stones. Porous, sandy loam, organic rich soil is preferable. The site should receive adequate sunshine. The morning sun, up to mid-day is very important.

Important cultural hints for roses

(i) ROSE PLANTING

The budded plants are planted during October or November or at any time when it is not very cold or hot. In summer, generally, no planting is done.

(ii) PLANTING DISTANCE

The cultivars of commercial importance should be planted at the spacing of 60×60 cm. To get blooms on long stems, close planting is followed. The spacing, however, depends upon the climate, varieties and soil types (e.g. 30 × 20 cm, 30 × 30 cm and 30 × 40 cm).

(iii) IRRIGATION

After roses have been planted, they are irrigated regularly, preferably at 6-8 days intervals.

One heavy watering at long intervals is much better than frequent light irrigations for proper root growth. To ascertain whether a plot needs irrigation, the soil is stirred up to 5 cm deep in 2 to 3 places. If the soil is still wet, no irrigation is needed immediately.

(iv) PRUNING OF ROSES

Rose plants are generally pruned once a year for good flower production. In northern India, pruning is done with the onset of the winter season. In places having a mild climate, like Bangalore, pruning is done twice a year. The first pruning is done at the end of June and the second during the last week of November. The exact timing is determined by the prevailing temperature conditions.

The pruning stimulates new, vigorous growth, which gives better flowers in larger quantities. It also regulates the size and shape of the plant. The following points should be kept in mind at the time of pruning.

- (a) Prune dead and small inter-laced branches.
- (b) Remove the diseased and insect damaged plants.
- (c) Always prune to an eye pointing outwards.
- (d) In Hybrid Tea, strong branches should be pruned up to 5 to 6 eyes.

(v) DISBUDDING

To obtain extra large flowers, disbudding may be practised in

Hybrid Tea. This should not be done in other types of roses.

(vi) REMOVAL OF SUCKERS

The budded plants, especially during the first two years, occasionally throw up suckers from the base of the parent stock. If these are allowed to grow, they may kill the budded plant. Any growth of a sucker (which comes below the bud joint) should be removed immediately.

(vii) APPLICATION OF ROSE-MIX FERTILIZER

Some commercial preparations of fertilizers for roses like "Rose-Mix", "Flowerex" etc. are available in the market. The following mixture can be prepared at home also.

5 Kg groundnut cake

5 Kg bonemeal

2 Kg ammophos (11.48)

1 Kg sulphate of ammonia

2 Kg superphosphate (Singh)

1 Kg potassium sulphate

It is applied 50 to 100 gm per plant just after pruning and once again after about 1½ to 2 months from the date of pruning.

(viii) OTHER CULTURAL OPERATIONS

The rose plants should be kept free from weeds. If the soil is too wet, it is not possible to weed them out. Therefore, three or four days after watering, the surface soil should be hoed for removal of weeds. Hoeing should be practised only

up to a depth of 5 to 7 cm from the top soil. Otherwise, the surface roots which are the principal feeders may get damaged.

(ix) PROTECTION OF ROSES AGAINST INSECT-PESTS AND DISEASES

There are various insect-pests and diseases that may afflict roses. Amongst pests, white ants, thrips, greenfly and mites are important. Die-back, powdery mildew and black spot are the serious diseases. They should be controlled by spraying suitable insecticides and fungicides.

(x) HARVESTING, PRE-COOLING AND PACKING OF FLOWERS FOR EXPORT

Harvesting

- Flowers are cut in the bud stage, when sepals curl backwards
- Flowers are cut before sunrise
- Flower stems should be 60-90 cm in length
- Flower bud must not be too tight

Pre-cooling

- Cut-blooms are immediately placed in containers full of water up to the neck
- They are recut in water about 2 cm above the previous cut end
- Roses in containers filled with water are stored at a cool temperature of 5°C (40°F), for 6 to 12 hours to harden the buds and enhance their keeping quality.

Packing

- Blooms are graded according to colour, stem length, etc.

- The thorns from flower stems are removed up to 20 cm from the base of the stem for easy handling
- The flowers are bunched in round bundles
- The stem portion is wrapped in wet newspaper
- The whole bunch is wrapped in soft white butter paper or polythene and packed in cardboard cartons.
- White tissue paper is spread over the top and then the carton is closed and fastened with a strong piece of string and labelled
- No vacant space is left in the carton, otherwise the blooms will be shaken too much during transportation

13.3 Precautions

- Select the appropriate site for commercial cultivation of roses
- Be sure about the varieties
- Take all care in cultivation
- Spray the plants in time against insect-pests and diseases
- Observe thoroughly all techniques under harvesting, pre-cooling and packing for export.

13.4 Materials Required

- Tractor with plough
- Garden tools and implements like spade, pickaxe, secateurs, *khurpi*, baskets, etc
- Measuring tape, line rope
- Budded rose plants

- Labourers and trained gardeners
- Cartons, tissue paper, butter paper, etc

13.5 Procedure

- Fence the rose plot properly.
- Plough the field thoroughly with a tractor
- Dig the pits for planting to proper depth (45 × 45 × 45 cm)—maintaining proper space
- Procure budded plants of the desired, recommended varieties
- Keep the recommended cultural hints in mind and plant the roses accordingly
- Follow the cultural practices rigorously
- Guard the plants against insect-pests and diseases
- Protect the plants against climatic hazards.
- Take particular care of plants if any kind of blemishes appear on the rose petals, as they are not acceptable in foreign markets
- Harvest and pack the flowers for export or sale as per recommended practises.
- Survey the market occasionally to find out demand and current prices

13.6 Observations

- Pupil should study the various rose cultivars and a record has to be made as follows.

13.6.1 To study duration between pruning and flowering period

Sl No	Name of rose cultivars	Date of planting	Date of pruning	Time taken to first flowering from the date of pruning
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13.6.2 Study of branches and flowers of commercially important rose cultivars

Sl No	Name of rose cultivars	Total no. of branches per plant	Total no of flowers per plant	No of flowers having more than 60 cm stem (for export)	No of flowers having less than 60 cm stem (for local market)
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13.6.3 General study of rose cultivars (at flowering stage)

Sl No	Name of rose cultivars	Size of opened flower (cm)	Colour of flower	Scented or not	Duration of bloom on plant after being cut
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13.7 Expected Behaviour Outcomes

The pupil should acquire the ability to:

- select the site for commercial rose cultivation;
- cultivate roses for commercial purposes;
- recognize varieties of commercial importance;
- know the characteristics of export rose cultivars;
- harvest and pack the roses for export purposes;
- Know the importance of rose cultivation

The teacher should evaluate the pupil for the above abilities

13.8 Questions

- (i) Which rose cultivars are commercially important?
- (ii) Name a few rose cultivars of red and yellow colours
- (iii) Why are suckers from the base of a rose graft removed?
- (iv) What are the names of fertilizer mixtures available in the market and how are they applied for rose plants?
- (v) What are the classes of roses? Explain
- (vi) What do you know about harvesting, pre-cooling and packing of rose blooms?
- (vii) What are the important insect-pests and diseases of roses?
- (viii) Write a short note on rose pruning.

ACTIVITY UNIT 14

Training and Pruning of Shrubs

14.1 Instructional Objectives

The pupil should be able to.

- learn all about training and pruning,
- know the different methods and types of training and pruning
- understand the principles of training and pruning;
- know the category of plants that need training and pruning;
- train and prune horticultural plants

14.2 Relevant Information

What is training and pruning?

Training and pruning is the art of removing any part of the plant-branch, leaf, flower, fruit or root and directing the growth of the plant in a desired way

Why is it done?

It is done to divert the energy to the productive areas so as to increase the production; to develop a strong framework of the plant; to remove dead and diseased branches, to remove the unproductive and criss-crossing branches; to have the proper air circulation and to expose all the parts

to sunlight; to give proper shape to the plant, to control the plant height, to improve the quality of the produce and to rejuvenate the plant.

How is it done?

There are two methods of pruning such as heading back and thinning out. Heading back consists of removal of terminal parts of the stem or root. If it is severe, it is known as hard pruning. If only a portion of the tip is removed, it is known as light pruning. Thinning out consists of removal of excess, dead or diseased branches, flowers, fruits, roots or leaves. Pruning is done to control the plant height as in the case of hedges and to increase the production as in the case of flowering plants.

There are different types of training like central leader, open centre or modified leader. In the central leader system, only the laterals are removed and the main stem is allowed to grow without any restrictions. In the open centre system, the main stem is pruned to make the plant assume a spreading habit of growth. This is done in order to regulate the plant height, to give proper shape and to

develop a strong framework of the plant.

Vigorous and fast growing shrubs need heavy pruning to restrict their growth. A weak plant is pruned to get vigorous and juvenile shoots. Hardy plants with a dense canopy and small leaves which stand pruning such as *Casuarina*, *Bougainvillea* and *Clerodendron* may be used for developing topiary by pruning and training.

14.3 Precautions

- Do not prune during the bearing season
- Prune in order to get an open bush
- Prune only to the required level and to achieve the desired objective
- Prune the plants to keep the vegetative growth of the plant under control and to get maximum yield per unit area

14.4 Materials Required

- (i) Secateurs
- (ii) Garden shears
- (iii) Pruning knives
- (iv) Pruning saw

14.5 Procedure

- Take a secateur, pruning knife or a garden shear as required
- Decide the purpose and the level of pruning
- Identify the parts of the plant to be pruned.
- Prune them to the required level
- Always cut above a bud tending to

grow in an outward direction

- The cut surface must be clean and should be painted with coal tar or fungicide
- Train the remaining parts properly
- Clean the tools and return them to the store

14.6 Expected Behavioural Outcomes

The pupil should be able to

- decide the time of pruning,
- decide the method of pruning,
- decide the level of pruning;
- know the tools to be used for pruning,
- understand the purpose of pruning,
- prune the plants accurately

The teacher should evaluate the pupil for the above abilities

14.7 Questions

- (i) What is training?
- (ii) What are the different methods of training?
- (iii) What is pruning?
- (iv) What are the different methods of pruning?
- (v) Make a list of the plants which are suitable for hedges.
- (vi) What is topiary?
- (vii) What is a standard? What are its uses?
- (viii) What is juvenility?
- (ix) Why are the cut surfaces cleaned and painted?
- (x) Why is the cut given above a bud?

ACTIVITY UNIT 15

Designing Public Parks

15.1 Instructional Objectives

The pupil should be able to

- appreciate the need of parks in a city,
- know about different types of city parks and their features
- landscape the traffic islands in the street intersections
- know about the trees and other plants used in a city park,
- learn about various items of recreation and playing equipment in a park,
- design different types of city parks,

15.2 Relevant Information

Why is a park needed?

A park is considered to be the lungs of a city. In congested cities, parks are the only places where people get fresh air and a place to stroll. The city park should be a place of beauty and utility. It has high recreational value for the citizen.

Different types of city parks

The city parks can be categorized into the following.

A. LARGE RURAL PARK

Parks laid out in the vicinity of a city,

in the countryside are easily approachable by common means of transportation. Because of congestion in old cities, space for parks is generally not available. Hence, such rural parks are laid out.

This type of park usually comprises

- (i) A long meadow
- (ii) Undulated and rising hilly section
- (iii) A lake and its surroundings
- (iv) A number of scenarios and objects of beauty

Such parks are normally 200-1000 acres in size. Generally, the area of such parks is determined by the financial potentiality of the local body or administration planning to develop such parks in the vicinity of a city.

B. A SMALL CITY PARK

The size of this type of park may be anything between 5-100 acres or a little more. The features of such parks are:

- (i) Good flowering and shade trees in groups or singly
- (ii) Strolling space
- (iii) Benches
- (iv) Shrubbery
- (v) Garden adornments (e.g. statue, fountain)
- (vi) Some area under lawn

- (vii) Zig-zag paths
- (viii) Sitting arrangement
- (ix) Flag pole
- (x) Drinking water spot

C PLEASURE GROUND

The third kind of city park is known as a pleasure ground and here, large areas are allotted for games. Often, play fields are the main features of such parks. The other features are:

- (i) A restricted swimming pool
- (ii) Swings, slide chutes, merry-go-round, see-saw, etc. are provided if the park is meant for children.
- (iii) Some trees, shrubs and beds of Canna. It is difficult to maintain grass in such parks due to heavy usage.

Landscaping traffic islands

In many cities from small to large squares are left in the road intersections. These islands are planted with a view to be soothing for the eyes of the people passing by. Some people may use these for resting if these are large enough and there is not much traffic. These islands normally have a lawn, a few beds of Canna and some beds of annuals. In large islands, one or two medium-sized flowering trees may also be planted. Sometimes, they are also provided with fountains, decorative lighting arrangements and statues.

Trees, shrubs, etc. for city parks

The city parks should have some flowering and shade trees. The flowering trees may be planted in groups in a corner. If the park is large, trees may be planted in an avenue. Trees for

providing shade are planted near the benches provided.

FLOWERING TREES

- (i) Gulmohar
- (ii) *Lagerstroemia flos-reginae* (roadside planting)
- (iii) *Tecoma argentea*
- (iv) *Cassia renigera*
- (v) *Cassia javanica*
- (vi) *Bauhinia variegata* (roadside planting)

SHADE TREES

- (i) *Mimusops elengi*
- (ii) *Ficus infectoria*
- (iii) *Samanea saman* (for large parks)
- (iv) *Ficus religiosa* (for large parks)
- (v) *Filicium decipiens*
- (vi) *Grevillea robusta*

OTHER TREES

- (i) *Oreodoxa regia* (avenue planting) (Royal Palm)
- (ii) *Ravenala madagascariensis* (specimen plant)
- (iii) *Putranjiva roxburghii* (avenue planting)
- (iv) *Callistemon lanceolatus* (specimen tree in lawn or near water garden)
- (v) *Thuja orientalis* (in row around playgrounds)
- (vi) *Plumeria white*
- (vii) *Polyalthia longifolia*
- (viii) *Casuarina*

SHRUBS

- (i) *Brya ebenus* (as specimen in lawn near water garden)
- (ii) *Holmskioldia sanguinea* (may be trained well)
- (iii) Hawaiian Hibiscus (in beds)

- (iv) *Ixora singaporensis* (as specimen)
- (v) *Mussaenda philippica* (as specimen)
- (vi) *Callindra*
- (vii) *Tecoma*
- (viii) *Pentas*
- (ix) *Plumbago*
- (x) *Tabernamontana*

One or a few shrubberies may be arranged

FLOWER BEDS

Beds of Canna, Rose, hardy annuals and herbaceous perennials (e.g. Michaelmas daisy, *Mirabilis Jalapa*, *Solidago canadensis*, etc.) may be planted

Items of recreation, etc

A few benches made of concrete may be provided. Some statues, bird-bath fountains can also be erected. In a children's park, the following playground equipment may be provided.

- (i) Swings
- (ii) Merry-go-round
- (iii) Slide chute
- (iv) See-saw
- (v) Snail, caterpillar, etc. (made of pipes for climbing)
- (vi) Sand pits

OTHER FEATURES

It is also possible to have features like a lily pool, rock garden, arch, pergola, rose garden, bird-bath fountain, etc. in a park

15.3 Precautions

- Avoid planting items requiring much maintenance

- Take care of the underground sewage lines and overhead electric telephone wires
- Do not use materials like iron, wood, etc. for construction of garden benches. These are likely to be stolen. Moreover, benches made of iron become too hot in summer and too cold in winter
- Prepare the design and take to the spot, and make changes if any
- The initial design is to be prepared in pencil. If changes are required afterwards, the pencil drawing could be erased

15.4 Materials Required

- (i) Drawing board
- (ii) Printed graph paper (good for initial drawing, as design can be made easily as per scale), tracing paper, drawing paper or poster paper for drawing
- (iii) Soft lead pencils
- (iv) Good rubber or nylon eraser, geometry instrument box, scale.
- (v) All drafting equipment

15.5 Procedure

- Mark the outline first
- Plot the entrance, roads, paths, and playgrounds
- Demarcate the area for play equipment (itemwise) in a children's park.
- Select the site for the swimming pool.
- Select the sites for lily pool and rock garden (if any)
- Decide about avenue, shade and flowering trees
- Plot the specimen trees and shrubs

- Design the shrubbery
- Draw everything in pencil first, so that alterations can be made, if needed.
- Follow a uniform scale of 1:15 or 1:20.

15.6 Observations

The pupil should take the following observations

- (i) Use of proper symbols for different features
- (ii) Use of proper scale
- (iii) Numbers of all the features and their description on a separate sheet of paper
- (iv) Existence of underground sewage line or overhead wires, natural or artificial structures, if any

15.7 Expected Behavioural Outcome

- The pupil acquires the ability to
 - prepare a plan for different types of city parks,
 - learn about the symbols used for different items,
 - know the features needed for different categories of city parks,
 - visualize the play equipment needed for a children's park,
 - utilize the different plant materials appropriately

The teacher should evaluate the pupil for the above abilities

15.8 Questions

- (i) Why is a park needed in a city?
- (ii) Suggest play items for a children's park
- (iii) What are the different features of a "Pleasure Ground" in a city?
- (iv) Identify from the following trees the flowering and shade type trees.
Samanea saman, *Bauhinia variegata*, *Tecoma argentea*, *Ficus infectoria*, *Grevillea robusta*.
- (v) Where will you use the following plants for a city park?
(a) *Oreodoxa regia* (b) *Ravennala madagascariensis*
(c) *Callistemon lanceolatus* (d) *Brya ebenus* (e) *Hawaiian hibiscus*
- (vi) Why should benches made of wood or iron not be used in a city park?
- (vii) How will you draw a landscape plan for a public park?
- (viii) What is a preliminary plan?
- (ix) What are the principles behind the selection of park land?
- (x) One of the principles involved in the selection of park land is to secure adequate land for a park that will be accessible for all sections of the city in advance of the proposed development of the section (True or False?)

ACTIVITY UNIT 16

Planning Institutional Grounds

16.1 Instructional Objectives

The pupil should be able to:

- appreciate the importance and objectives of landscaping in an institution;
- design a garden which needs minimum labour for maintenance,
- improve the landscape of an unplanned compound,
- plant the frontage;
- know about the trees to be planted in the periphery, on the avenue and roadside in a campus,
- know about the role played by shrubs in an institutional garden.
- learn about the foundation planting;
- develop the recreation area in an educational institute,

16.2 Relevant Information

The importance and objectives

In India, most campuses of educational institutes are barren, without any garden. A properly landscaped campus adds beauty to the school building. Moreover, a well-maintained campus inculcates an aesthetic sense in the future citizens. The main objectives of landscaping are to create

a barrier against noise, wind and air pollution and also to provide shade and beauty

Role of master plan

It is necessary to prepare a master plan at the very start to prevent any haphazard growth in the future. The authorities may implement the master plan of the garden in phases as and when the budget permits. This type of plan is largely a display plan. Its main aim is to show the scheme, stress is laid on this point and each and every feature of the plan of any importance is indicated and named.

Design a garden with minimum maintenance

A lawn, flower beds, hedges needing frequent trimming should not be included in a design. These need more labour for maintenance. Emphasis should be on planting trees, shrubs, Cannas, etc., which need less attention.

How to landscape an existing unplanned compound?

- (a) A creeper like *Bougainvillea* or *Bignonia venusta* may be trained

on the front wall, near the entrance

- (b) A few shade and flowering trees may be planted in the compound or in the periphery.
- (c) If no space is available, the frontage and corridors may be decorated with potted plants.

What to plant in the front boundary?

The building should not get obscured from view for this reason, dwarf flowering trees with good spacing (10 m apart) should be planted. The trees suitable are *Tecoma argentea*, *Bauhinia variegata*, *Lagerstroemia floribunda*, *Cochlospermum gossypium*, etc

Trees for the periphery

The objective of planting on the boundaries (3 sides) other than the frontage is to create a barrier against sound, dust and wind. Of course, the aspect of beauty should also be taken into account. The first row on the boundary should be closely planted (3.5 m depending upon the trees) with trees having good canopy of foliage. This row will arrest dust and reduce noise and wind. Suitable trees are Silver oak, *Polyalthia longifolia*, *Putranjiva roxburghii*, *Samanea saman* (for large compounds), etc. To create beauty (if space permits) one row of flowering trees should also be planted in the front of these trees. The trees suitable for this are *Cassia fistula*, *C. marginata*, *C. nodosa*, Gulmohar, *Tecoma argentea*, *Bauhinia variegata*, etc. A few trees like *Eugenia Operculata*, *Erythrina indica*, etc. may be planted in some secluded corner which attracts birds. A bird-bath may

also be provided near these trees.

Avenue and roadside trees

Medium and dwarf flowering trees should be planted. If an overhead wire is present trees like *Tecoma argentea*, *Cochlospermum gossypium*, bottle brush, etc. may be planted.

Role of shrubs

Shrubs planted in formal beds or rows may be planted along small paths. Around play fields, instead of a hedge (as this needs regular clipping), shrub borders may be planted which need less maintenance.

Foundation planting

Beds of flowering annuals should be avoided as foundation planting near the entrance of the building. These need more attention. Instead, borders of low-growing and trailing shrubs should be planted, as these require less maintenance.

Is a lawn necessary?

A lawn keeps down dust and adds beauty to the surroundings. But this requires a lot of attention. If maintenance is possible, some selected places may have a lawn.

16.3 Precautions

- Do not plant tall trees in the front which will obstruct the view of the building.
- Avoid planting items requiring more maintenance like beds of flowering annuals, a lawn, etc.
- Make it a point to prepare a master plan at the very beginning.
- Take into account the under-

ground sewage pipes and overhead wires.

16.4 Materials Required

- (i) Drawing board
- (ii) Tracing paper, drawing paper or poster paper for drawing
Printed graph paper is good for initial drawing as per scale. Afterwards, this can be traced
- (iii) Soft lead pencils
- (iv) Good rubber or nylon erasers, scale, geometry instrument box
- (v) Drafting set

16.5 Procedure

- Prepare a master plan for the whole institute
- Mark out the items to be implemented in different phases, according to the available budget
- Plot the buildings and driveways first
- Mark the different features with a pencil, so that any alternations thought of afterwards can be made.
- Follow a uniform scale of 1:15 or 1:20.

16.6 Observations

The pupil should take the following observations:

- (i) Use of proper symbols for different features.
- (ii) Use of proper scale.
- (iii) Put numbers for all the features and their description on a separate sheet of paper

16.7 Expected Behavioural Outcomes

The pupil acquires the ability to:

- prepare a master plan for an educational institute;

- learn about the trees suitable for planting at various places,
 - spell out the objectives of landscaping an educational institution,
 - develop a garden which needs minimum maintenance;
 - know the importance of plant material in landscape planning
- The teacher should evaluate the pupil for the above abilities

16.8 Questions

- (i) Describe the importance and objectives of laying out a garden for an educational institution
- (ii) Which of the following trees are suitable for planting under an overhead electric wire line?
Polyalthea longifolia, *Tecoma argentea*, *Cochlospermum gossypium*, *Samanea saman*
- (iii) The garden of an educational institution should have a large number of beds of flowering annuals
Yes/No
- (iv) The flowering tree ----- is suitable for planting on the front boundary wall, whereas ----- is suitable for planting in the periphery.
- (v) Suggest ways of motivating students in the maintenance of gardens
- (vi) One drawback of modern school grounds is that enough space is not provided for proper school development
True or False
- (vii) Straightness must always be the fundamental consideration in the layout of walks and drives for school grounds
True or False

(viii) In a school ground 50% of the entire area is too much for the development of the recreation area
True or False

(ix) In designing the structures and layout of a school ground, it is important that the landscape

designer and building architect work together
True or False

(x) In designing the play areas for older children and younger children, it is not desirable to separate the areas by either a fence or a thick hedge
True or False

ACTIVITY UNIT 17

Designing a Home Garden

17.1 Instructional Objectives

The pupil should be able to

- learn about a home garden, its various components, their purpose and importance;
- design home gardens to scale, maintaining perfect harmony with the environment and personal taste

17.2 Relevant Information

Why is a home garden needed?

A garden in a home not only adds to its beauty, but also enhances the real estate value.

Why should the preference of the owners be known?

The personal taste of the owner should be taken care of. The home, including its surroundings, should be an outward expression of the personality and individuality of the owner.

What should be the background of a home garden?

The background, whether a wall, tall trees or a hedge should be neutral in nature. This means the background should not distract the attention from the main garden. A green hedge as background is neutral. But a red

hedge of *Acalypha* may distract attention from the garden.

Why an open centre?

The central area of the garden should be left out of any feature of major importance. It is best to put this area under lawn. A lawn in the centre gives a perspective of spaciousness to a property. A bushy shrub in the central lawn will counter the principle of spaciousness. But a tree branching at a higher level (e.g. Silver Oak i.e., *Grevillea robusta*) planted in the lawn does not obstruct the view at ground level.

Importance of scale

A master plan of the garden has to be prepared. The owner may implement the plan in phases depending upon convenience and budget. A scale of 1:15 or 1:20 is convenient. That means if a flower bed is 20 cm in width, in the plan the width will be shown as 1 cm. The house, wall, driveway, paths, flower beds, shrubberies, etc. should be spotted in the plan. Any possible shaded area due to large trees or building should be marked in the plan. The planner should visualize what shape and form a tree or shrub should take after 10-15

years. Before implementing a plan it should be studied again and again, and additions and deletions may be made.

How to bring variety?

To break monotony in a garden, variety is essential. This is achieved by utilizing plant material in design. Planting several beds of different red-flowered annuals does not mean variety. But a bed of red salvias, against the background of a green hedge is a good contrast.

Purpose for which the garden is needed

Before making a plan it should be ascertained what the owner wants. The choice may be any of the following.

The garden is needed as.

- (a) an outdoor living room (i.e., drawing room) with long stretch of lawn and terrace (raised area)
- (b) a fenced-in playground
- (c) a showpiece with a collection of rare plants
- (d) a place for producing cut flowers, vegetables and some fruits. Some people may prefer to have in a corner some trees which attract birds (e.g. *Eugenia operculeta*, *Erythrina indica*). If a place is desired as an outdoor living room, more areas should come under lawn, with minimum areas of borders, shrubs and flower beds at the outskirts. People who wish to grow vegetables will prefer more area under this.

Some common problems encountered during planning

If the owner wants to reduce the labour cost, this can be partly achieved by the following

- (a) Plan a hedge which does not need frequent clipping and shearing (e.g. some *Acalypha* sp.)
- (b) Limit the numbers of beds of annuals to the minimum. More areas to be put under shrubbery, herbaceous border, which need less attention.
- (c) A lily-pool needs occasional cleaning involving labour. This may be excluded.
- (d) Water faucets should be fitted in appropriate places. This will reduce the exercise of dragging the hose pipes to long distances.

What are the different sectors?

If the area available for gardening is large enough, it should be divided into the following areas.

A. APPROACH OR PUBLIC AREA

This is the area from the public road-side and extending to the building

- (i) This area should not be overcrowded with large trees. Big trees may be planted at the back.
- (ii) It should have a spacious lawn with a specimen tree (if the area is large).
- (iii) A herbaceous perennial border, a few annual beds and foundation planting (near the doorway) can be included in this area.

B. WORK OR SERVICE AREA

- (i) This area and the living area

should have privacy, and preferably be situated at the back

- (ii) It includes the kitchen garden, compost bin, nursery, tool-shed and garage. Children's play area with swings etc. can be situated here.
- (iii) The area is to be screened off by a thick hedge, or a row of bushy shrubs
- (iv) The service area should be screened with light creepers (e.g. railway creeper) on a trellis, or an ornamental hedge (e.g. *Eranthemum*)
- (v) If space permits, a tennis court or badminton court may be included

C PRIVATE GARDEN AREA OR LIVING AREA

The living area is the outdoor living room of the house

How to design irregular shaped plots

Some plots, especially corner plots, may be irregular in shape. The following may be kept in mind in designing the same;

- (a) Such plots should be designed informally
- (b) A corner having an irregular shape may be allotted for an informal-shaped lily pool
- (c) Beds and borders should be shaped informally according to the contour of the plot
- (d) Laying out formal paths may be avoided, instead stepping stones should be provided to reach different spots

Features of a home garden

Depending upon the choice of the owner, a number of features can be included like a shrubbery, borders, annual beds, rose garden, rock garden, lily pool (if desired), etc. A owner who can afford it, may have a greenhouse to grow decorative foliage plants. Garden adornments like a statue, sun-dial, bird-bath, benches, fountain, etc., may be included

Places needing more attention

The doorway needs to be treated specially as this receives more attention from a visitor. This should be designed with much care and thought. Perennial and annual flowers should be planted. If planting in the ground is not possible, pot plants can be arranged. A rose garden can be designed provided the place receives the morning sun. An ornamental light, post or Japanese lantern can be placed in a suitable place.

Trees, shrubs, etc. for a home garden

Various ornamental and flowering shrubs and flowering annuals and herbaceous perennials can be planted. Flowering trees like *Bombax malabarica* (in a large compound), *Erythrina indica* may be planted in a corner to attract birds. Flowering trees like Cassias, Gulmohar, *Michelia champaca*, *Bauhinia variegata*, etc., can be planted in the backyard.

Designing a small compound

A small area cannot be divided into various areas (like public area, living

area, etc). Such compounds should have:

- (a) A small lawn
- (b) One or two specimen shrubs (e.g. *Brya ebenus*, *Cassia biflora*, *Mussaenda philippica*, *Ixora singaporensis*, etc)
- (c) Places having shade should have herbaceous perennials like *Impatiens sultanii*, geranium, ornamental foliage plants

Designs for a country home

Our country homes need more area under vegetables and fruits, and a playground for children. But some scented flowering trees like *Nyctanthes arbor-tristis*, *Michelia champaca*, *Plumeria* or a shade tree may be planted. Flowering shrubs and annuals which yield flowers for worship and hair adornment like Jasmine, *Hibiscus rosasinensis*, *Crossandra*, Marigold, China Aster may be included.

17.3 Precautions

- Do not neglect the arrangement of the three essential portions of any home lot development i.e., the approach, the service and the living portions in relation to each other on the lot.
- Take into account the shaded areas. Most of the flowering annuals, roses etc fail to bloom properly under shade. These areas should be allotted to ornamental foliage plants, shade-loving herbaceous flowers.
- The designer must be able to visualize what shape and form a plant will take in the years to come.

- Do not plant tall trees under overhead wires
- Before drawing your plan, study carefully the legends and other specimen plans of gardens

17.4 Materials Required

- (i) Drawing board
- (ii) Tracing paper, drawing paper or poster paper for drawing garden plan. Printed graph paper is good for the initial drawing, as it is easy to draw everything on scale.
- (iii) Soft lead-pencils
- (iv) Good rubber or nylon erases, scale, geometry instrument box
- (v) Drafting set

17.5 Procedure

- Draw the outline of the compound
- Plot the house
- Show the driveway, garden paths
- Plot the different features with a pencil, so that, if need be, alterations can be made
- Divide the whole area into compartments
- Complete the drawing by plotting all the items.
- Follow a uniform scale of 1:15 or 1:20 while drawing

17.6 Observations

The pupil should take the following observations:

- (i) Use of proper scale
- (ii) Marking of the shaded areas in the design
- (iii) Marking of the flower beds, shrubbery and trees.
- (iv) Numbers to all the features in the drawing and their description on

- a separate sheet of paper
- (v) Use of proper symbols for different features

17.7 Expected Behavioural Outcomes

- The pupil acquires the ability to
- use the proper symbols for depicting trees, shrubs, etc.
 - divide the garden area into several sectors.
 - know the common features of a home garden
 - utilize a shaded area in the garden properly
 - make plans for different types of home compounds.
 - suggest a layout for a country-home.

The teacher should evaluate the pupil for the above abilities.

17.8 Questions

- (i) What should be the background of a home garden?
- (ii) What is meant by an 'open

- centre' and why it is advocated?
- (iii) How is a large home garden divided into various areas?
 - (iv) *Eugenia operculata* is a tree which attracts -----
 - (v) Name some features of a home garden.
 - (vi) What garden adornments can be incorporated in the design?
 - (vii) The following trees'
 - (a) -----
 - (b) -----
 are suitable for a country-home
 - (viii) How will you design an irregular-shaped plot?
 - (ix) A work or service area should include the following'
 - (a) -----
 - (b) -----
 - (c) -----
 - (x) Which are the most important basic areas to be considered when planning the development of home grounds?

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